The Dissertation Committee for Michelle Anne Wolfe Certifies that this is the approved version of the following dissertation:

Problem Expansion and Solution Containment: News Coverage and the Climate Debate

Committee:

Bryan D. Jones, Supervisor

Samuel Workman

Sean Theriault

Scott Moser

Problem Expansion and Solution Containment: News Coverage and the Climate Debate

by

Michelle Anne Wolfe, BA; MA

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Dedication

This is dedicated to my Mom, Penelope Anne Wolfe. You continue to teach me how to be brave, where to find joy, and when to be stubborn. I love you and I miss you.

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Problem Expansion and Solution Containment: News Coverage and the Climate Debate

Michelle Anne Wolfe, PhD

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Supervisor: Bryan D. Jones

This project focuses on how news coverage of climate change structures policy debates to examine its role in slowing down the momentum for large-scale policy change, such as cap-and-trade legislation. I present a theory of media signaling in what I call the "muddled space" of policy debates on complex problems, and apply it to the issue climate change. I argue that there is a dual role for media influence in the muddled space: it prioritizes attention to policy problems, but also limits the comprehensiveness of solutions used to fix them. On problem expansion, findings suggest that two aspects of news coverage – attribute diversity and volume – amplify problem uncertainty in policy debates and heighten disputes over its severity and are thus important factors in prioritizing the climate problem. Causal uncertainty in news coverage – doubt about the linkages among human actions, global warming, and climate impacts – makes it less likely that the climate problem will be on the policy agenda. But once it *is* on the agenda, causal uncertainty seems to mobilize policy brokers around strategies to define the climate problem and delineate its solutions. On solution containment, findings suggest that high levels of causal uncertainty is a limiting factor for the generation of large-scale climate solutions, such as cap-and-trade. I also find that attribute diversity and causal uncertainty in news coverage play an important role in increasing the likelihood that

policy debates on climate solutions will converge around incremental approaches to fixing it, such as energy efficiency measures. This study is important because it demonstrates that the influence of news coverage on public affairs is quite large in its ability to moderate attention to policy problems and their attendant solutions. The "muddled space" helps explain why complex problems get "stuck" in cycles of policy debates over problem definitions, which leads to less effective solutions employed to solve them. Finally, this study also helps explain why the US is such a laggard in terms of climate policy.

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Chapter 1: Introduction

> We need to look at the science and be honest about the uncertainties associated with climate change… In order to impact global emissions, we must shift from costly subsidies and regulations to research and technological solutions that will be used not only here but around the world. In other words, let's set aside the fiction and focus on a real solution.[1]

Representative Lamar Smith (R-TX), Chairman of the House Committee on Science, Space, and Technology, penned this op-ed for the *Texas Tribune* in 2013 to mobilize opposition against the Obama Administration's Climate Action Plan to set limits on carbon pollution from power plants. In this piece, Rep. Smith highlights the uncertainty in the science that links extreme weather events to climate change, insisting this this connection is more due to "exaggerated claims" by politicians. In light of the "uncertainties associated with climate change," he argues that research and technological solutions, such as carbon capture, are the "real solutions" – not subsidies and costly regulations. A version of this op-ed was also published in *The Hill* and the *Washington Post*.[2]

This is a common tactic used by opponents of comprehensive solutions such as cap-and-trade – emphasize uncertainties in the climate problem to steer debate towards less costly, incremental approaches to addressing it. In the midst of debating cap-and-trade legislation in 2007, Senator Ted Stevens (R-AK) admitted that climate change *was* a serious problem, but that legislation for greater fuel economy standards was a more appropriate solution given that "we need to look at other possible causes of climate

[1] Op-Ed by Rep. Lamar Smith (R-TX) October 15, 2013 in the *Texas Tribune* https://www.texastribune.org/texas-weekly/vol-30/no-38/guest-column-severe-weather-climate-change-not-lin/

[2] http://the hill.com/opinion/op-ed/325971-extreme-weather-isnt-linked-to-climate-change (accessed November 2013); https://www.washingtonpost.com/opinions/lamar-smith-overheated-rhetoric-on-climate-change-hurts-the-economy/2013/05/19/32cb6d94-bda4-11e2-97d4-a479289a31f9_story.html (accessed April 2016).

change," such as solar radiation.[3] His colleague, Senator Christopher "Kit" Bond (R-MO), echoed this reasoning in arguing for biofuels and energy efficiency measures until both the scientific and policy communities better understood climate impacts.[4]

Climate change has been a fixture of elite policy debates since 1988, but as of 2016 Congress has yet to pass comprehensive climate legislation. We have however passed many bills to fund research on climate science, clean energy technologies, and to reduce greenhouse gas emissions through less costly, incremental solutions. Our counterpart, the European Union, has had a cap-and-trade system in place since 2005. Why is the United States such a laggard in terms of large-scale solutions to fixing the climate problem? One of the oft-cited culprits for policy stagnation is climate news coverage (Boycoff and Boycoff 2004, 2007; Schmid-Petri et al 2015; Painter 2011; Painter and Ashe 2012). In fact, the House in 2007 held a hearing to examine how media organizations distort science in climate news.[5] Despite this, questions of if and how news coverage influences climate policy remain largely untested in the academic literature.[6]

Climate change is one of the most heavily politicized, diabolically complex policy problems of our time (Steffen 2011; Boykoff and Yulman 2013). In this dissertation, I focus on how news coverage has structured climate policy debates to examine its role in slowing down the momentum for large-scale policy change. I present a theory of media signaling in what I call the "muddled space" of policy debates on complex policy problems, and apply it to the issue of climate change. I argue that the role of the media here is one of problem expansion *and also* solution containment. What does this mean? It

[3] Climate Change Research and Scientific Integrity, Senate, 110th Cong., 2007.
[4] Vice President Al Gore's Perspective on Global Warming, Senate, 110th Cong., 2007.
[5] Shaping the Message, Distorting the Science: Media Strategies to Influence Science Policy, House, 100th Cong., 2007.
[6] For an exception, see Liu et al (2011).

means that news coverage induces competition and conflict among policy communities over how to understand the climate problem. This expands its scope and makes it a priority issue on the policy agenda. Put simply, climate change *is* a problem considered worth solving in some fashion in large part *because* the media covers it. Then how do we arrive at solution containment? We arrive here because the *way* the media covers climate change matters – it induces problem expansion, but at the same time, limits the set of politically feasible policy alternatives that will be seriously considered to solve it.

How does this happen? I focus on how three aspects of news coverage – attribute diversity, causal uncertainty, and volume – structure policy debates that encourage prioritizing the climate problem, but also steer debate towards limiting its scope of solutions. The first aspect of news coverage, attribute diversity, leads to amplifying problem uncertainty in policy debates – how is the climate problem best understood? This is contestation among policy communities over how to define the climate problem and delineate its solutions (Baumgartner and Jones 1993; Sabatier and Jenkins-Smith 1993; Kingdon 2003). The second aspect, causal uncertainty, increases the tenuousness of the linkages between the causes and the consequences of climate change. This intensifies disputes in policy debates about problem severity – what is causing global warming and is global warming a serious threat? This is contestation among policy communities over causal stories that (dis)connect activities with unwanted outcomes that warrant government intervention. These are fundamental as precursors to problem prioritization and policy change (Stone 1988, 1989; Rochefort and Cobb 1994; Cobb and Elder 1972; Baumgartner and Jones 1993). The third aspect, volume, elevates the salience of climate change in policy debates – how important is it that we pay attention to and solve the climate problem? The role of the media in driving issue salience is a well-known

component of policy change (Baumgartner and Jones 1993; McCombs 2008; Van Aelst and Walgrave 2006).

Chapter 2: Media Signaling in the Muddled Problem Space

This dissertation is organized into five substantive chapters. Chapter 2 provides the theoretical foundations of media signaling. It introduces the contributor and conduit approaches to understanding media influence that inform the theory of media signaling. These were bore out of the policy processes and communications literatures, respectively (Baumgartner and Jones 1993; Jones and Baumgartner 2005; Bennett 1990, 1996, 2002). The theory of media signaling offered in this project is grounded in the information-processing perspective of information flows in policy debates (Simon 1983; Jones and Baumgartner 2005; Workman 2015). Chapter 2 thus provides an overview of the information-processing framework, focusing on the relationship between attention limits and problem prioritization, disproportionate information-processing, positive and negative feedback, and the attribute diversity and causal uncertainty attached to complex policy problems. Chapter 2 introduces the "muddled problem space" in which policy debates over complex problems take place. It also includes a discussion of how the media operate in subsystem policymaking, which are the loci of competition and conflict over policy problems (Baumgartner and Jones 1993; Sabatier and Jenkins-Smith 1993; Thurber 1991).

Chapter 3: Problem Expansion and Solution Containment

Chapter 3 explicates the problem expansion and solution containment argument based on the theory of media signaling, and as applied to climate change. News coverage elevates the climate problem. It organizes and prioritizes policy attention. It activates competition and conflict over which attributes define climate change in policy debates. It also moderates disputes over causal relationships that are used by policy communities to

advocate for either limited or comprehensive solutions. The nature of news coverage – the three aspects attribute diversity, causal uncertainty, and volume – heighten already intense debates over the climate problem. The nature of news coverage also increases existing uncertainties about climate change. In light of so much unsettled uncertainty, news coverage limits climate solutions to those that do not have as many consequences for resource allocation, government intervention, and complicated regulatory regimes.

This dissertation looks at how news coverage influences problem prioritization and solution generation in policy debates. This maps back onto problem expansion and solution containment, respectively. The theory of media signaling suggests that policy communities as a whole will prioritize the climate problem as attribute diversity and volume of news coverage grows. This is because these are media signals that focus policy attention and mobilize competition over problem definition in light of problem uncertainty and the importance of climate change. Policy communities will be less likely to prioritize the climate problem as a whole, however, as causal uncertainty in news coverage increases because its severity and need of government redress will be called into question. High-profile policy brokers are crucial players in the problem definition process (Kingdon 2003; Baumgartner and Jones 1993; Sabatier and Jenkins-Smith 1993; Mintrom and Norman 2009). The theory of media signaling also implies that policy brokers acting on behalf of policy communities will respond to all three media signals once the climate problem is on the policy agenda – an arena in which conflict and competition are already at elevated levels.

Regarding the generation of solutions and their containment, the theory of media signaling suggests that large-scale climate solutions in policy debates will decrease with attribute diversity and causal uncertainty in news coverage because these signals amplify problem uncertainty and highlight disputes over how severe are the climate impacts.

Volume of coverage should have the opposite effect – it should increase large-scale solutions because its signals the growing importance of fixing the climate problem. We should see completely different dynamics for the relationship between news coverage and incremental solutions. The theory of media signaling implies that limited approaches to fixing the climate problem should become more prominent in policy debates with attribute diversity and causal uncertainty in climate news coverage. This is because these media signals increase the political feasibility and policy tool appropriateness of less costly, smaller-scale alternatives in light of high levels of problem and causal uncertainty. Again, we should see volume have an opposite effect because the signal of importance will shift debates away from less effective solutions toward either comprehensive approaches or efforts to better understand how the climate problem should be characterized.

To test the expectations that are laid out in Chapter 3, this dissertation uses four dependent variables that are derived from a dataset based on over 400 congressional hearings on climate change from 1987 to 2012. The three independent variables for climate news coverage of attribute diversity, causal uncertainty, and volume are from a dataset of almost 5,000 newspaper stories from the *New York Times* and the *Washington Post.* Both of these datasets are coded for climate policy content using an innovative two-step machine-human hybrid approach to analyzing political texts. The result is an expansive dataset that includes information on the number of large-scale and incremental climate solutions in policy debates based on a set of nine possible types of solutions mentioned in opening statements and witness testimonies at congressional hearings. The dataset on the media is coded for over 30 unique attributes of climate change found in news coverage, as well as a thorough accounting of reporting on climate science to

capture causal uncertainty. These datasets on solutions and climate attributes in the news are the most extensive of their kind.

Chapter 4: News Coverage of Climate Change, 1987-2012

Chapter 4 takes the media signals attribute diversity, causal uncertainty, and volume and ties them explicitly to a detailed history of how climate change has been covered in the news from 1987 to 2012. This chapter is organized into three sections, one for each of the three media signals. These sections contain a discussion of the relationship between the signal and subsystem (i.e. policy community) responsiveness, an overview of the journalistic practices behind them, and an accounting of how each signal appears in the content of climate news. This chapter incorporates the contributor and conduit traditions introduced in Chapter 2 and shows how increases in news volume index to events, elite conflict over climate policy, and scientific controversies. It lays out what attribute diversity in climate coverage looks like, where it comes from, and how it has been covered. This chapter also explains how news coverage of climate science produces an overemphasis on causal uncertainty, and how this important dimension has ebbed and flowed over time as one of the dominant news frames.

Chapter 5: Prioritizing the Climate Problem

Chapters 5 and 6 address the problem expansion and solution containment argument by modeling how news coverage structures policy debates on climate change, focusing on problem prioritization and solution generation, respecitvely. Chapter 5 on problem expansion examines how attribute diversity, causal uncertainty, and volume influence how policy communities prioritize the climate problem. Prioritizing policy attention is a necessary precursor to coming up with its solutions (Jones and Baumgartner 2005). Does news coverage influence problem prioritization, and if so, how? This chapter uses two indicators of prioritization – congressional hearings for policy communities as a

group and the number of opening statements made at these hearings as a proxy for policy brokers prioritizing climate change. Findings from this chapter suggest that attribute diversity and volume of news coverage moderate problem uncertainty and disputes over severity and are thus important factors in prioritizing the climate problem. The number of congressional hearings and opening statements increase alongside growth in these media signals. Causal uncertainty in climate news lowers the priority of the problem among policy communities as a group, making it less likely to be up for debate on the policy agenda. But once it *is* the subject of formal debates, causal uncertainty seems to prioritize the climate problem among policy brokers. Chapter 5 also demonstrates support for disproportionate information-processing of signals coming from news coverage. Findings suggest that only clear and strong signals of causal uncertainty influence problem prioritization by way of congressional hearings. Policy brokers seem only to respond when volume of news coverage is a clear and strong media signal as well.

Chapter 6: Limiting Climate Solutions

Chapter 6 on solution containment examines how the three aspects of news coverage – attribute diversity, causal uncertainty, and volume – structure the scope of climate solutions considered in policy debates. Does news coverage encourage limited approaches to solving the climate problem, as implied by the logic of media signaling in the muddled space? This chapter develops a typology of climate solutions to address this question – which are large-scale and incremental solutions that map on to the effectiveness of policy alternatives to reduce greenhouse gas emissions. Findings suggest that high levels of causal uncertainty in news coverage is a limiting factor for the generation of large-scale climate solutions, such as cap-and-trade measures. The results for both attribute diversity and volume's influence on large-scale solutions are in the expected direction, but their estimates do not reach statistical significance. This chapter

also looks at how media signals structure the generation of smaller-scale, less costly solutions to the climate problem, such as efficiency increases and enhancing green technologies. Findings imply that attribute diversity and causal uncertainty in news coverage play an important role in increasing the likelihood that policy debates on climate solutions will converge around incremental approaches to fixing it. Volume of coverage has the opposite effect, as expected – signals that amplify the importance of the climate problem seem to steer policy debates away from incremental solutions and perhaps toward further deliberating the problem in order to fix it. Results from this chapter also support disproportionate information-processing of some media signals flowing from news coverage, in that signals of causal uncertainty seem to need to be clear and strong before policy communities respond to them.

Chapter 2: Media Signaling in the Muddled Problem Space

This dissertation presents a theory of media signaling from the information-processing approach to studying policy change. Media influence is the result of how news coverage interacts with what I call the muddled problem space that characterizes complex policy problems, such as climate change. This dynamic produces information signals about policy problems to which policy communities respond. This chapter is organized into four sections. The first provides an overview of the contributor and conduit approaches to understanding media influence – the two literatures on which the theory of media signaling is based. The second section addresses crucial aspects of the information-processing framework to understanding media influence on policy change. The third section introduces the muddled problem space that characterizes complex policy problems. The fourth section is a discussion of how the media fits in with subsystem policymaking – the forum in which the problem definition process occurs.

MEDIA SIGNALING: COMBINING THE CONTRIBUTOR AND CONDUIT PERSPECTIVES

As Bryan D. Jones and I have argued elsewhere (2010), media influence from the information-processing perspective in the policy process is best understood in terms of interinstitutional signaling (see Workman 2015 for a comprehensive application to the bureaucracy). Expanding on Jones and Wolfe 2010 (and Wolfe et al 2013; Wolfe 2012), this project investigates how policy communities (also known as subsystems) in governing institutions respond to media signals about heavily politicized complex policy problems. This project uses two frameworks (see Table 2.1) to develop a theory of media influence based on signaling. To be sure, it expands notions of influence based on information processing from the contributor approach and incorporates the journalistic

norms and practices used by news organizations to cover political and public affairs from the conduit approach.

Table 2.1: The Characteristics of the Contributor and Conduit Approaches to Media Influence

	Contributor	Conduit
Field	Policy Process	Political Communication
Behavioral Explanation	Information-processing	Journalistic norms and practices
Literature	Punctuated Equilibrium Theory	Indexing
Agenda	Policy	Media
Information Flow	Media → Government	Government → Media
Influence on Policy Change	Punctuations	Status quo
Mechanism	Positive feedback	Index to elite conflict

The most important commonality bridging these two approaches is that they both focus on elite debate, or in other words, on conflict. From the conduit perspective, news coverage is indexed to conflict, but it does not *cause* conflict. The parameters of elite debate are reflected in the news on public affairs, but such coverage does not help *shape* such debate. One implication of the conduit approach is that policy does not change in any sort of meaningful fashion absent a departure from official elite sources (Bennett, 1996, 2003; Lawrence 2000; Bennett, Lawrence, and Livingston 2007; see also Sparrow 1999 from an institutions perspective). This is one of the most important ways in which these two frameworks diverge. According to the contributor literature, referencing elites from outside the dominant policy coalition or more peripheral subsystem participants has direct implications for policy change. In this camp, news coverage is a mechanism for positive feedback and conflict expansion, which are precursors for policy punctuations.

There are a couple of additional important points of departure between the contributor and conduit approaches that lead to opposing conclusions of media influence on policy change. First, each emphasizes different agendas and information flows. The

contributor tradition focuses on the flow of information from the media to the government agenda to explain policy change. Conversely, the conduit framework centers on information flows from elites to the media to explain source selection. Second, the two approaches generally differ in the duration of the time period under investigation. From the contributor perspective, long periods of time (10-20, and even 50+ years) are a prerequisite for examining policy change. The conduit subfield generally produces relatively shorter case studies (of the qualitative and quantitative variety). The conduit approach is not incompatible with the contributor's view (and findings) that news coverage driven by elite conflict can foment policy change; rather, its approach to studying the government-media relationship biases findings toward the status quo.

In the parlance of the contributor framework, bias toward the status quo is attributed to negative feedback processes – forces that induce stability in policymaking. However until very recently (Wolfe 2012; Jones and Wolfe 2010; Wolfe et al 2013), the contributor literature had not engaged in studies that looked at the negative feedback effects brought on by news coverage. To be sure, negative feedback from this perspective does not mean policy stasis, but instead processes that dampen momentum for punctuated changes in policy. This project extends the work bore out of the contributor approach by including an examination of how the nature of news coverage can contribute to negative feedback. Situated in PET's information processing framework, news coverage is conceptualized as signals that character the state of policy problems. Under the right conditions, these signals are detected, prioritized, and used as opportunities by those involved in policymaking to better understand the problem at hand and to further their own goals. Depending on the nature of news coverage, information signals from the media aid in expanding problems (positive feedback) and containing the scope of the

solutions that would help solve them. These approaches are combined to explain climate news coverage in detail in Chapter 4.

INFORMATION-PROCESSING: AN OVERVIEW

Is the influence of news coverage better understood as either conduit or contributor, or can it be both? This project presents compelling reasons why media attention to public affairs facilitates both stability and change, both negative and positive feedback effects. One reason is because the notion of influence is supplanted by the fundamental importance of signaling. An additional reason is because this project focuses on how the media influences complex policy problems, using climate change as a theory-building case study. This chapter is devoted to explaining media influence on complex problems from the information-processing perspective.

The information-processing approach is rooted in the fundamental question of how political institutions respond to incoming information (Jones and Baumgartner 2005; 2015). This perspective puts a premium on information as inputs into the system directing the allocation of attention. Key here is the notion that this involves a process of weighting and reweighting issue importance and the reorganization of problem prioritization. Work in this vein grew from the tradition of Simon (1947), was extended by Jones (1994; 2001), and by Jones and Baumgartner (2005; 2015). The role of the media from this perspective is understood as one of several important inputs into the policymaking process that directs the allocation of attention (Wolfe et al 2013).

Baumgartner and Jones' seminal work *Agendas and Instability* in 1993 encouraged a punctuated approach to understanding media influence in terms of attention dynamics. The contributor camp has subsequently generated a multitude of studies confirming and providing nuance to the positive feedback role of the media (Jones and

Baumgartner, 2005; Boydstun 2013; Walgrave 2011; Wolfe et al 2013), buttressing the notion that there is a role for news coverage in the information-processing approach to policymaking (Jones and Wolfe, 2010).

The contributor tradition of agenda setting focuses on problem recognition and (re)definition, necessarily putting much research at the front-end of policymaking (Cobb and Elder 1972; Rochefort and Cobb 1994; Stone 1988, 1989; Baumgartner and Jones 1993; Kingdon 2003). This perspective thus centers itself on the problem space in decision contexts at the systems-level, which is characterized by an *oversupply* of information and an *undersupply* of attention (Newell and Simon 1972; Jones 1994; Baumgartner and Jones 2015; Workman 2015). What follows from examining media influence from an information-processing perspective is an emphasis on how attention limits, disproportionate information processing, negative and positive feedback, and the dynamics between complexity and uncertainty shape government agendas and policy outcomes (Wolfe et al 2013). These concepts are crucial to understanding the role of the media as information signaler and to linking problem expansion and solution containment to news coverage.

The Relationship Between Attention Limits and Prioritization

Governing institutions are at heart about problem-solving (Workman 2015; Baumgartner and Jones 2015). Following the logic of attention limits, a primary task of political institutions is prioritizing policy problems. This prioritization process is at its core about detecting and categorizing information in an effort to define the problem at hand. As such, policymakers spend a great amount of time operating within a pluralistic problem space (Jones and Baumgartner 2015; Workman 2015). This space is characterized by an oversupply of information about public policy provided by a

multitude of diverse sources, including interest groups, think tanks, political parties, bureaucracies, congressional committees, state and local governments, researchers, and media organizations. These are inputs into the system – signals -- about policy problems.

In order to attend to problems, understand their magnitude, and extract their relevant dimensions in the pluralistic problem space, policymakers and the institutions they embody are tasked with detecting and prioritizing multiple information streams. Instead of *searching* for information, policymaking in the problem space is about weighting the bombarding *supply* of information (Jones 2001; Jones and Baumgartner 2005). When Congress is prioritizing, it is deciding which issues, and what dimensions, are relevant – and which are not. This problem prioritization process is how the information-rich environment is winnowed to set – and change -- the policy agenda.

Disproportionate Information-Processing

Political institutions, because they are hampered by human and organizational limitations that cause "friction" or "stickiness" in the system, are disproportionate information-processors (Jones and Baumgartner, 2005; Jones 2001; Baumgartner and Jones 2009; Workman, Jones and Jochim 2009). Disproportionate information processing causes both negative *and* positive feedback. It leads to overreacting to some vague or relatively subtle signals and underreacting to other signals that are clear and strong. In a pluralistic policymaking environment, it is virtually impossible to react proportionately to the "objective reality" of incoming information. Since policymaking institutions have limited capacities, agenda space is finite. Attending to issue X, Y, Z or honing in on one of these issues attendant attributes X_1, X_2, X_3 necessarily means that they are *not* attending to issues A, B, C or attributes X_4, X_5, X_6.

Though "not the whole story" (see Jones and Baumgartner 2005, p 51), disproportionate information-processing implies room for threshold effects for the theory of media influence based on signaling. Small changes in the volume or content of news coverage occurring in a sea of competing information signals will not always trigger (re)action from policy communities. Disproportionate information-processing suggests that in some contexts, especially if the information environment is saturated, shifts in attention will only come about as a response to higher-than-normal changes in media coverage. For example, Wolfe (2012) finds that the speed of lawmaking slows down much more drastically with high levels of news coverage. This is a fruitful avenue for research, as signal strength based on news coverage and its effects on policymaking is under-investigated.

Positive and Negative Feedback

Policy agendas and outcomes are characterized by periods of relative stability interspersed with dramatic change by scholars in the contributor tradition of punctuated equilibrium theory (PET). The same aforementioned constraints and points of friction – attention limits and institutional structures – produce both equilibrium by dampening the flow of information (negative feedback) and considerable movement away from the status quo by amplifying information flows (positive feedback). The policy processes perspective emphasizes both positive and negative feedback in policymaking (Kingdon 1984; Baumgartner and Jones 1993; Sabatier and Jenkins-Smith 1993; Workman 2015). Though since the overriding goal is to explain agenda and policy change, we see a lot of scholarship in this vein focusing on positive feedback processes operating in the context of a bias toward equilibrium states. This is especially the case when analyzing the role of the media (Baumgartner and Jones 1993).

Put succinctly by Baumgartner and Jones (2002, p 13), positive feedback is "a self-reinforcing process that accentuates rather than counterbalances a trend." By amplifying information signals, positive feedback can be an explosive, destabilizing force that produces large adjustments in policy outcomes. Some positive feedback mechanisms in economics and politics include social mimicking (Schelling 1978; Bartels 1988), cue-taking in political institutions and the policymaking process (Mathews and Stimson 1975; Kingdon 1973; Baumgartner et al 2009), and issue bandwagons and contagion effects (Baumgartner and Leech 2001; Halpin 2011; Boushey 2010; Thomas 2015).

Positive Feedback and the Media: Focusing Events

Oftentimes focusing events or "triggering devices" can carve out agenda space (Cobb and Elder 1972; Downs 1972; Kingdon 1984; Baumgartner and Jones 1993; Birkland 1997, 1998; Hilgartner and Bosk 1988) by shifting attention, thereby introducing new and elevating newly-redefined policy problems. This happens especially when the media latches onto them. Events and policy problems are often linked in news coverage due to the journalistic need for contextualization and the imperative for interpretation -- called the routinization of reporting (Bennett 2002; Tuchman 1978). Environmental disasters, such as Three Mile Island, or natural disasters and extreme conditions such as hurricanes and heat waves linked to global warming, receive such treatment from the media. When this happens, harm and risk become an amplified attribute of the policy image, creating a window of opportunity for problem redefinition.

For example, environmental (and fishing) policy advocates seized a window of opportunity provided by media coverage of the oil spill from the Exxon Valdez to shift attention to alternative attributes of the problem definition and policy solutions, which led to a revision of existing laws (Birkland 1997). With the policy monopoly for nuclear power already in decline, media and congressional attention to the negative aspects of

nuclear energy dramatically increased following the meltdown at Three Mile Island on March 28, 1979 (Baumgartner and Jones 1993, pp 65, 75), leading to a massive regulatory overhaul of this sector. The attribute-issue linkage provided by the media and driven by "dramatic real-world events" is especially important for increasing attention to and the legitimacy of complex, organizationally fragmented environmental issues such as climate change (Unger 1992). In this policy arena, we often see news coverage indexed to legislative events, climate summits, the release of high-profile scientific reports, and scientific controversies (Trumbo 1996; Liu et al 2008, 2013; Boykoff and Boykoff 2004, 2007; Shehata and Hopmann 2012)

Positive Feedback and the Media: Venue-Shopping

Venue-shopping is integral to understanding policy change from the policy processes perspective (Baumgartner and Jones 1993; Sabatier and Jenkins-Smith 1993; Wilson 2000). The media can also be a positive feedback force by acting as an alternative venue for policy advocates to increase the salience of their issue (Baumgartner and Jones 1993; Cobb and Elder 1972; Hilgartner and Bosk 1988), which expands the scope of conflict. This strategy is undertaken in order to redefine the issue with the ultimate goal of changing policy in a desired direction. Issue advocates often use news coverage as a tool for mobilizing interests – public and elite -- outside of closed policymaking subsystem. This is a particularly well-known strategy in environmental politics (Pralle 2003, 2006), especially in the United States with its political system characterized by multiple venues (Green-Pederson and Wolfe 2009). It is a well-established tactic used by climate change skeptics (Oreskes and Conway 2010; McCright and Dunlap 2003). Pesticides policy is a classic example. Baumgartner and Jones (1993) link changes in pesticides policy to shifts in how it was covered in the news – from positive frames of scientific progress and productivity to negative frames associated with health and

environmental risks (pp. 103-125). Part of what drove coverage was elite conflict. It can be seen that shifting to the mass media as a venue for issue attention can lead to positive feedback, and hence act as an avenue for problem expansion.[7]

Negative Feedback and the Media

Oftentimes in the contributor tradition, media attention is conceptualized as a mechanism for positive feedback – as a venue for advocacy groups to disrupt policy monopolies. But the logic of PET combined with the journalistic standards and practices from the conduit approach suggests that news coverage can also an equilibrium-inducing forum. Some research demonstrates support for this. Wolfe (2012) finds that the speed of lawmaking slows down as media attention to the policy process grows. Boydstun (2013) argues that the media acts as a negative feedback force when covering public affairs in "patrol mode." Indexing to elite debate, prizing conflict, and being duty-bound to present "fair and balanced" coverage (Bennett 1990, 1996, and 2002), the media is also a venue for dominant coalitions – policy monopolies – to counter-mobilize claims and policy frames. By doing this, these coalitions are aiming to reinforce the status quo, effectively pressing the brakes on the momentum for policy change.[8]

We see this in the coverage of policy areas with significant scientific and/or technological components, from second hand smoking, ozone and acid rain, to global

[7] This project focuses on the mass media (*New York Times* and *Washington Post*). Though sometimes specialized media can mobilize policy communities, resulting in direct access or as a platform for galvanizing attention from the mass media (see for instance Nelson 1986 and Liu et al 2011).

[8] We see explanations for negative feedback mechanisms in distributional studies (Fiorina 1977; Shepsle and Weingast 1987) and informational models (Krehbiel 1991) of Congress, in the principle-agent literature focusing on the bureaucracy (McCubbins and Schwartz 1984), incremental decisionmaking in public administration (Lindblom 1960; Wildavsky 1964; Simon 1997), adjustments in public opinion in response to government activity (liberalism/conservatism) (MacKuen, Erickson, and Stimson 2001; Wlezien 1995), and pluralist models of American politics and public policy focusing on counter-mobilizing forces such as interest groups and policy monopolies, i.e. closed subsystems (Lowi 1969; Schattschneider 1960; Truman 1951; Baumgartner and Jones 1993).

warming. For example, Rothman and Lichter (1982) found far greater consensus surrounding the safety of nuclear reactors among experts in the policy community than what was portrayed in the media. In climate change, another heavily politicized scientific issue, there is a vast literature documenting the overemphasis of uncertainty in climate science cause and effect relationships related to global warming in news coverage (Boykoff and Boykoff 2004, 2007; Antilla 2005; Zehr 2000, 2009; Schmid-Petri et al 2015; Painter and Ashe 2012). Besides being a product of journalist norms and practices, we also see this as a strategy. These skeptics use the media to alter the perception of either a growing consensus or agreement that is already widespread (Oreskes and Conway 2010).

In fact, the media was blamed for misrepresenting climate change by *both* proponents and opponents of large-scale solutions, such as cap-and-trade. On March 28, 2007, the U.S. Congress's House Committee on Science and Technology's Subcommittee on Investigations and Oversight held a hearing entitled Shaping the Message, Distorting the Science: Media Strategies to Influence Science Policy. In his opening statement, then-Chairman Brad Miller (D-NC) said before the panel and audience:

> Ronald Reagan said that facts were stubborn things. … . The topic of today's hearing is a consorted effort by opponents of measures to reduce greenhouse gas emissions, to bully scientific facts into submission, and, under intense pressure, the facts about global swarming caved in and proved much more elastic, much less stubborn than Ronald Regan had us believe.

Just a year prior to this, the Senate Committee on Environment and Public Works held a hearing entitled Examining Climate Change and the Media (2006) that claimed the opposite – that the media did not give enough space to skeptics and was partly

responsible for creating "alarmist" rhetoric surrounding the global warming political debate. In his opening statement, Chairman Inhofe (R-OK) warned that:

> Poorly conceived policy decisions may result from the media's over-hyped reporting. Much of the mainstream media has subverted its role as an objective source of information on climate change into a role of an advocate.

Attribute Diversity and Causal Uncertainty

The theory of media signaling emphasizes attribute diversity and causal uncertainty in news coverage of complex policy problems. Complex policy problems such as climate change are characterized by multiple attributes and several causal relationships that connect actions – either unguided or purposeful (Stone 1989) – with consequences (Baumgartner and Jones 2015). These characteristics are crucial components of a problem definition, which is a set of cause and effect relationships that is solvable and worth solving (Dery 1984). Problem definitions elevate conditions to problems in need of government redress (Kingdon 2003) and structure the sets of solutions considered by policy communities to fix them (Newell and Simon 1972). The information-processing approach to policy change emphasizes the dynamics of complexity in the problem definition process (Baumgartner and Jones 1993, 2015; Jones and Baumgartner 2005; Jones 1994a,b, 2001).

Climate change is by its very nature a complex process that involves multiple inputs, outputs, and feedback loops – both positive and negative – long time lags, and abrupt changes, called "climate disruptions" (Steffen 2011). It is also complex as a public policy problem for a host of other reasons as well. First, the scope of its potential impacts is far reaching, potentially debilitating, and costly – food shortages, population displacement, infrastructure damage to name a few. Its comprehensive solutions cap-and-trade or a carbon tax are also quite complex – they involve multiple industrial sectors,

economic rearrangements and income redistribution, and complicated regulatory regimes. The combination of its scientific nature and the politics of climate policy debates means that its problem definition is often unstable, ill-understood, and subject to jurisdictional challenges (Rabe 2007; Liu et al 2015).

Attribute Diversity

Most policy problems are inherently complex in that they are structured by multiple attributes, which means there are potentially several ways to understand and characterize them – and a myriad of ways in which to solve them (Jones 1996, 2001, 1994; Baumgartner and Jones 2005, 2015). The problem space is the arena for the problem definition process. In policy debates, the problem space is characterized by multiple attributes that are reshuffling in the importance attached to them (Kingdon 2003; Jones 1994a,b). Policy change can be explained by this attribute reshuffling, which is often the result of new information – i.e. signals – entering into the system.

In an individual choice context of a single policymaker, what may appear as a change in mind may actually be a change in focus – attention shifting to previously underweighted attributes that characterize the policy problem (Jones 1996, 1994a). This attribute intrusion also occurs at the institutional level, the U.S. Congress for example, when new attributes of a problem definition enter into policy debates. This expands disrupts status quo policymaking in closed subsystems, elevating debate to larger policy arenas where a greater number of policy participants compete over the problem definition. Disruptions such as these can lead to agenda and policy change (Baumgartner and Jones 1993, 2015; Jones and Baumgartner 2005; Worsham 1997).

Attribute diversity introduces uncertainty into the problem space when the variety and concentration of attributes tied to a problem definition change. Uncertainty here means that those operating in the policy community are not clear as to the veracity of

which attributes best characterize a policy problem – both in terms of its objective nature and political receptivity. This uncertainty increases competition and conflict among subsystems over defining the problem. Thus it also provides opportunities to change the course of policymaking. As previously discussed, the media plays a large role in the problem definition process by directing policy attention. It can foment attribute intrusion by covering some attributes at the expense of others, amplifying the already existing uncertainty surrounding the problem definition. In a theory of media signaling, news coverage of policy problems should have a role in structuring uncertainty in the problem space via attribute diversity in reporting the news on public affairs (Wolfe et al 2013).

Causal Uncertainty

The lack of clarity in causal connections that link actions with consequences is a second form of uncertainty that is particularly potent for complex policy problems (Baumgartner and Jones 2015). Causal mechanisms and their effects are often ill-understood with such issues as climate change, economic growth, national security, poverty and healthcare. These policy problems are actually composed of multiple cause and effect relationships where causal linkages (mechanisms) are fuzzy, in dispute – and sometimes – unaccepted. Why is causal uncertainty important in the problem definition process? Clarity in causal stories – connecting an activity with an unwanted outcome that warrants government intervention – has been shown to be a precursor for problem prioritization and policy change (Stone 1988, 1989; Rochefort and Cobb 1994; Cobb and Elder 1972; Baumgartner and Jones 1993).

The causal clarity of a policy problem directly impacts its perceived severity, mediating debate over the seriousness of the problem and its consequences. Elite conflict over causality relating to the severity of a problem is often picked up by the media (Rochefort and Cobb 1994). For example, wide disagreement on the facts surrounding the

"extent, timing, and impact" of global warming among policy communities was – and still is – a storyline that can be found in climate change news coverage (Stevens 1991 B12 and Samuelson 1992 in Rochefort and Cobb 1994, p. 17). When news organizations cover "causal politics" (Stone 1989), they send signals regarding the uncertainty of cause and effect relationships, which in turn amplifies this already-disputed nature of the policy problem. This then feeds back into debates surrounding the severity of the problem.

POLICY DEBATES IN THE MUDDLED PROBLEM SPACE

The previous section introduced the contributor and conduit perspectives to understanding media influence that inform how news coverage structures policy debates. It provided an overview of the key aspects from the information-processing approach to studying policy change that undergird the theory of media signaling. This includes the relationship between attention limits and problem prioritization; disproportionate information-processing and signaling threshold effects; how the media fits in with positive and negative feedback, highlighting events, venue-shopping, and indexing news coverage to elite debate; and it concluded with a discussion of attribute diversity and causal uncertainty.

This section introduces what I call the muddled problem space. It is the typical problem space from the information-processing approach – on steroids. Media influence is the result of how news coverage interacts with policy debates taking place in the muddled problem space that characterizes complex policy problems, such as climate change. Table 2.2 compares the characteristics of the muddled space with the problem and solution spaces of typical issues and the potential for media influence in each space.

Table 2.2: The Muddled Space of Complex versus Typical Policy Problems

Characteristic	Complex	Typical	
Context	*Muddled space*	*Problem-space*	*Solution-space*
Information	Vast oversupply	Oversupply	Preferences
Issue Attributes	Multiple, ill-defined	Multiple, under-defined	Few, well-defined
Causal Relationships	Multiple, uncertain and disputed	Range, in flux	Known, accepted
Severity	Contention, wide-range	Contention, narrow-range	Consensus
Competition	Open, boundary-spanning	Open, bounded	Closed, policy monopolies
Conflict	Protracted	In flux	Limited
Goal of Actors	Steer debate, negative *and* positive agenda-setting	Steer debate, positive agenda setting	Control, negative agenda setting
Media Influence	Large, frequent	Medium, occasional/during crises	Small, rare/specific to subsystem

Typical policy problems for the purposes of this project include "legacy" issues, which are problems that have a long history on the government agenda, such as education, veterans and older Americans issues, and agriculture (May et al 2006). While some of these may be structurally complex, they are not imbued with the same persistent degrees of uncertainty. In contrast, complex issues are relatively new; and, they can be heavily politicized. Policy problems that fall under this category include climate change, air pollution, homeland security, and global pandemics. Because of this distinction, the policy processes tradition knows a lot less about complex issues, especially in the realm of media influence.

Context and Information Supply

An important distinction between complex and typical issues is their contexts. I argue that complex issues operate in a third, muddled context that mostly revolves around problem recognition and (re)definition; they get "stuck" there. Typical issues operate in two contexts: the problem and solution spaces. While on the ground in policy debates problems and solutions often coexist, with solutions sometimes used to define problems, they are analytically distinct and can be thought of as practically distinct as well. The

ratio of policy debate on problems versus solutions is much higher during the recognition, definition, and agenda setting stages and inverse in the choice contexts and during policy implementation. For example, of the over 95,000 hearings Congress has held from 1946-2012, approximately 36,000 (37.8%) were called to debate policy solutions.[9] Of the 400-plus hearings on climate change, only 10% have centered on solutions. Typical issues cycle through this stylized policy process, and to be sure spend more time in the solution than the problem space (Baumgartner and Jones 1993). Complex issues can be different: the bulk of activity occurs in a muddled problem space.

As previously explained, the problem space is the loci of interest in the policy processes approach to studying information processing and agenda setting. The characteristics of complex policy problems that create the muddled space are explained from this perspective as well. What separates the muddled and "typical" problem space from the solution space are two notions of information: what it is and its availability. In the solution space, preferences and outcomes constitute information; and, its availability is limited and often withheld. This tradition is born out of economic theories of information (see Workman 2015 and Shafran 2015 for extensive overviews). In contradistinction, changes or "disturbances" in conditions and existing policies constitutes information in the muddled and typical problem space. Here, there is an oversupply of information in the policy environment. A wide range of sources send messages that contain varied and sometimes contradicting content.

The remainder of this section will focus on comparing the muddled and typical *problem* spaces, making reference to the solution space only in order to add clarification or nuance. This section will provide an overview of the table as it pertains to issue

[9] Data from http://www.policyagendas.org/page/datasets-codebooks#congressional_hearings (Accessed March 31, 2016).

attributes and causal relationships in the muddled space – and how they relate to competition and conflict among subsystems (i.e. policy communities). Subsequent sections in this dissertation go into detail regarding these characteristics, how they specifically relate to climate change policy debates in the muddled spaces, and how media signals structure these debates in terms of problem prioritization and solution generation (see Chapter 5 on prioritization and Chapter 6 on solutions).

Problem Uncertainty and Questioning Problem Severity

Here we focus on the characteristics that generate uncertainty in the problem definition process: multiple issue attributes and causal relationships. These characteristics create problem uncertainty – which attributes best define the policy problem? – and disputes over problem severity – what really are its impacts? In both the muddled and typical problem spaces, problems are characterized by multiple attributes. In the muddled problem space, the attributes that characterize a policy problem are many, often ill-defined, and subject to persistent reshuffling.

For example, Table 2.3 shows the 12 dimensions under which multiple attributes fall in policy debates about climate change.[10] Climate change is characterized by a wide-range of diverse attributes such as agricultural productivity, temperature trends, un/employment, disease, coastal erosion, alternative energy, mass transit, social welfare, conflict involving the U.S. military, technology R&D, international affairs, and extreme weather events such as hurricanes. And this is a limited list. Climate change has been a

[10] These were obtained by content coding opening statements and witness testimonies as part of the data collection and policy content coding effort for Chapter 6 on climate solutions in policy debates. See the section on research design for a thorough explanation of how the data were obtained and assigned attribute codes.

fixture of congressional policy debates since 1988. In that time, the dimensionality of debates has ranged from as little as one to as many as nine.[11]

Table 2.3: The Multiple Attributes of Climate Change in Policy Debates

Dimension	Examples of Attributes
Agriculture	Production, productivity, crop insurance
Climate Science	Carbon dioxide and global warming, human contribution, natural variation, temperature trends, computer modeling and simulations, climate impacts
Economics	Competitiveness, costs/benefits, employment ("green jobs"), program funding
Public Health	Disease, heat stroke/deaths
Environment	greenhouse gas pollution, air quality, coastal erosion, endangered species, resource conservation
Energy	Alternatives and renewables, efficiency and conservation, fossil fuels, nuclear, electric power
Transportation	Mass and alternative modes
Social Welfare	Low-income families
National Security	Role of US military in conflict, climate resilience
Technology R&D	Carbon capture, capacity building, technology
International	Treaties, cooperation, conferences, developing and industrializing nations
Weather & Natural Disaster	Hurricanes, heat/cold waves, droughts

But because typical issues have a legacy in political institutions and policy communities, they generally have fewer attributes, and the weights on the attributes experience less fluctuation (May et al 2006). This is directly related to the openness of competition in the muddles versus typical problem spaces. Subsystems are relatively open in the typical problem space, but they are less porous than in the muddled space of complex policy problems. This means that there is more stability for the typical problem definition; it is harder for attributes to intrude and destabilize current governing

[11] The number of unique dimensions in the sum of opening statement and witness testimonies for each hearing on climate change was used to calculate these dimensions of climate change. See Chapter 6 for a more detailed explanation and Table A.1 in Appendix A, Table B.1 in Appendix B for content coding.

arrangements. However, once a new dimension does take hold in policy debates surrounding typical issues, it is more likely to be incorporated and hence solutions formulated to account for it. This should not be the case for policy problems in the muddled problem space. The characteristics of attributes in the muddled space –multiple, ill-defined – encourages subsystem competition over problem definition, and hence conflict expansion. We can see how new attributes enter more easily in the muddled problem space. But at the same time, the high degree of problem uncertainty discourages comprehensive solution formulation (see Cobb and Elder 1972, pp. 111-115 for a discussion of the relationship between ambiguity and conflict expansion).

Turning to causal relationships in the muddled space of complex problems, there is a great deal of uncertainty about the mechanisms that link actions – either manmade or natural – with consequences. Multiple causal relationships define problems in the muddled space and they are often in dispute. For example, Rep. Lamar Smith (R-TX), Chairman of the House Committee on Space, Technology, and Science, highlights the causal uncertainties in climate change in an op-ed published by *The Hill* in 2013:

> Climate change is due to a combination of factors, including natural cycles and human activity. But scientists still disagree about how much each of these factors contributes to the overall climate change the Earth is experiencing. But understanding the causes of climate change is critical to developing a serious and effective solution.[12]

In the muddled space, even basic causal relationships go unaccepted, such as humans contributing to global warming (McCright and Dunlap 2003, 2010; Oreskes and Conway 2010). In the typical problem space, the clarity of causal relationships does fluctuate, but there is there is widespread agreement among subsystem participants about *basic* causes of the problem (Sabatier 1998, p. 113; Sabatier and Jenkins-Smith 1993, p. 133). For

[12] . Rep. Lamar Smith (R-TX) in *The Hill*, October 1, 2013. http://the hill.com/opinion/op-ed/325971-extreme-weather-isnt-linked-to-climate-change. (Accessed November 2013).

example, there is stable and subsystem-wide agreement that one of the basic causes of poverty – a typical issue – is under/ unemployment. The dispute is rather placed in arguments over antecedent aspects, like what causes under/unemployment. (AEI/Brookings 2015).

A tenant of causal stories is that they need to be accepted and made rather clearly in order for a condition to become a problem in consideration of government attention and deliberation. But what if causal stories *was* a major and persistent storyline, as they can be in news coverage of heavily politicized complex issues like global warming/climate change? The media covers causal conflict. In doing so, it sends signals back into the system that thwart convergence toward a path of consensus. This doesn't constrict debate over problem definition; rather, it amplifies conflict and thus political debate surrounding it. This occurs in one of several ways that involves both politics and good (i.e., thorough, data-driven) public policy. Scientists and other types of policy experts will seize upon causal conflict and use it as an argument to conduct more research that will refine causal understandings. Some will use it to as an opportunity to counter one causal story with another, or further defend it to opposing coalitions.

Uncertainty generated by attribute diversity and complex causal relationships helps shape the perception of problem severity. Both the muddled and typical problem spaces are characterized by contention over the overall seriousness of the problem. However the range of contention within the complex space is greater. Severity is mediated by how clear are the causes and consequences of a policy problem. Generally speaking, how important is it? The seriousness of disruptive extreme weather events and conditions, such as hurricanes and droughts – which can subsequently cause death, displacement, conflict, and famine for example – is discounted if there is a nontrivial

(i.e., politically salient) degree of uncertainty about and disagreement over what causes them and/or the ability to forecast them.

Elite conflict over the severity of a problem is fuel for the media pyre, especially when they can be dire. Many of the *potential* and real consequences of climate change are dramatic in their own right, like natural disasters. Some impacts brought on by global warming and climate change are somewhat slow to materialize, but cause great harm and broad suffering when they do. Conflict due to famine brought on by drought or a global infectious disease pandemics like malaria or Zika virus brought on by changing climates that produce more ecosystems hospitable to mosquitoes (Harvey 2016).

THE MEDIA AND SUBSYSTEM POLICYMAKING

The last section introduced the muddled problem space that characterizes complex policy problems like climate change. It focused on two important contributors of uncertainty in problem definitions: attribute diversity and causal uncertainty. This section addresses the characteristics of subsystems in the muddled spaced as compared to typical issues (please refer back to Table 2.2). These subsystem components are competition, conflict, and goals of the participants. Media influence in the muddled space will be addressed by discussing the behavioral logic that underlies interinstitutional signaling. Why do subsystems respond to media signals about policy problems? What drives news organizations' coverage of subsystem activity? In doing so, this section will further explicate how news coverage of subsystem conflict in the muddled space can lead to problem expansion, but also to the containment of their attendant solutions.

Defining the problem is the *sine qua non* for subsystems. Public policy is a function of who participates and how problems are defined. Subsystems compete over problem definitions – cause and effect relationships that are solvable and worth solving

(Dery 1984; Stone 1989) – to advance policy goals. Subsystems are organized around issues and are composed of coalitions of interest who engage in a non-trivial amount of coordination (Sabatier 1988; Sabatier and Jenkins-Smith 1993). Pluralist theories of the policy process emphasizing the dynamics of group competition and information flows view the potential for subsystem participation more broadly than their counterparts who underscore stable power systems. Instead of closed iron triangles (Lowi; Dodd and Schott 1979; Redford 1979), subsystems in pluralist theories of policy change allow for a broader scope of participation (Baumgartner and Jones 1993; Jones and Baumgartner 2005; Sabatier 1988; Sabatier and Jenkins-Smith 1993).

Figure 2.X provides examples of an iron triangle and an expanded policy subsystem.[13] The iron triangle depicts agriculture, the makeup of which is smaller in scope, and composed of a single dominant subsystem, compared to many other issues. Policymaking in an agriculture iron triangle is a result of the coordination among a congressional committee, a federal agency, and interest groups. This structure doesn't change much and hence policymaking here is relatively stable. In contrast, the composition of the expanded subsystem is much larger in scope and breadth. This depiction fits many complex policy problems, such as air pollution and climate change. For example, it includes research institutes and think tanks, multiple congressional committees, and regulatory *and* scientific agencies.

Most notably, national elite news organizations, such as the *New York Times* and *Washington Post*, are part of an expanded policy subsystem. Why are publications such as these included as if they are operating within policy subsystems? It is because they are

[13] Other terms that fit this depiction are policy communities (Baumgartner and Jones 1993), advocacy coalitions plus policy brokers (Sabatier and Jenkins-Smith 1993), and issue networks (Heclo 1978).

part of the flow of information that steers and structures policy debates.[14] The information they produce through news coverage of policy problems affects subsystem competition and the scope of conflict. They also are policy experts. News organizations such as the *Times* and *Post* employ "beat" journalists who specialize in particular policy areas, such as science and the environment. They also employ journalists whose specialties intersect science and politics, such as *Washington Post's* Joel Achenbach.[15] Andrew Revkin, who left the *New York Times* in 2009 after nearly 15 years, covered the relationship between climate science and politics.[16]

There are many boxes in the figure that depicts expanded policy subsystems. This is because the scope of participation is quite large. Given this, it is easy to see how coalitions competing over problem definitions are doing so in an environment with an oversupply of information. This is the case for both the muddled and typical problem spaces. However, some characteristics of subsystems in the muddled space increase the potential for greater media influence. First, while in both problem spaces, subsystems are relatively open – especially compared to the nearly impenetrable solution space – there is more competition in the muddled space compared to that of the typical. In the normal (i.e., typical) problem space, competition generally involves 2 or 3 subsystems (Thurber 1991, 332; Sabatier and Jenkins-Smith 1993). It is open; but it is also bounded. Complex policy problems, especially those with such wide-ranging effects as in the case of climate change, can span a greater number of subsystems. For example, May, Sapotichne, and

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[14] Specialized media, such as professional journals and newsletters, have a place in shaping the information flows in subsystems (Sabatier and Jenkins-Smith 1993; Thurber 1991). The influence of specialized media in Sabatier and Jenkins-Smith's (1993) advocacy coalition framework (ACF) and Thurber's (1991) notion of competitive subsystems comes from it facilitating adaptation and learning. Thus it is viewed as more a source of stability and subsystem maintenance than subsystem disruption. See Nelson (1984), Liu et al (2008) for the ability of specialized media to alter policy agendas.

[15] https://www.washingtonpost.com/people/joel-achenbach. (Accessed February, 2016).

[16] He continues to write the *Times'* Dot Earth blog http://topics.nytimes.com/top/reference/timestopics/people/r/andrew_c_revkin/index.html.

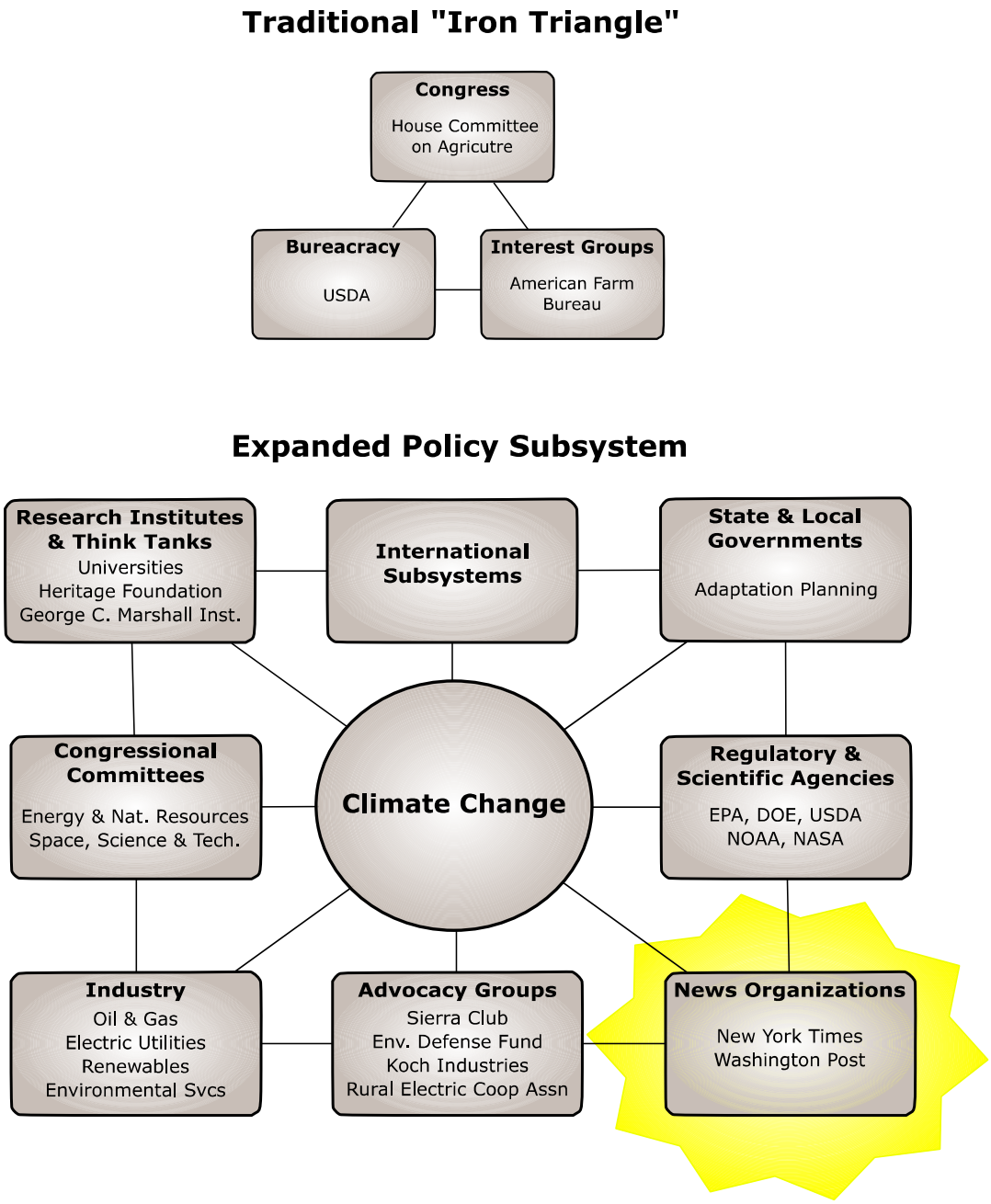

Figure 2.1: Iron Triangles and the Media in Expanded Policy Subsystems

Workman (2009) identified eight subsystems involved in homeland security, a complex and heavily politicized policy issue.[17] Climate change – a complex and heavily politicized policy problem where debate take place in the muddled problem space – has 13.[18]

Competition and Conflict

Why is there an imperative for subsystem competition in policymaking? Subsystems compete over problem definitions to maintain or gain jurisdictional authority over an issue (Baumgartner, Jones, and MacLeod 2000; Baumgartner and Jones 1993; Thurber 1991; Worsham 1997; Sabatier and Jenkins-Smith 1993: King 1997). The more complex the issue -- in terms of both causes and effects -- the more opportunities are afforded to outside players to steer debate *away* from one attribute toward another. These opportunities are increased in the muddled problem space that is also characterized by ill-defined attributes and hazy causal linkages, as they are by their nature susceptible to change. Jurisdictional battles, aka "turf wars", are subject to widespread publicity from the media (Thurber 1991, p. 332; Baumgartner and Jones 1993; King 1997).

News organizations have an incentive to report on this type of conflict among political elites. It hits the newsmaking imperatives for dramatization, novelty, and expert and elite sources, and routinized reporting (Bennett 2002, 1990, 1996; Gans 1979). For example, in 2007 the Committee on Foreign Relations in the Senate held a hearing on national security threats related to climate change.[19] This was the committee's first

[17] Homeland security fits many of the characteristics of a "muddled" problem space. However, there is far greater consensus on the seriousness of the problem among subsystems here than in for example, climate change.

[18] This is based on the number of committees that have held hearings on global warming/climate change since 1987. House and Senate committees were coded into policy domains, such as agriculture and energy, to avoid double-counting. Liu et al (2015) do not code committee for policy area and find 21 unique House and Senate committees have held hearings on climate change.

[19] Climate Change: National Security Threats, Senate, 110th Cong., 2007.

hearing on the climate problem in six years. Attaching national security threats to climate change makes it newsworthy is being linked to a policy area already institutionalized as such by news organizations (Tuchman 1979). The theory of media signaling suggests that uncertainty in the policy environment increases when the media cover attributes outside the scope of what "normally" defines a policy problem. If that signal is detected, subsystems responds with by flooding the environment with more information in an effort to compete over the problem definition.

We now turn to the second comparison of subsystem characteristics between the muddled and typical problem spaces: conflict. Greater competition and more uncertainty regarding the nature of the problem means that there is more capacity and likelihood for conflict expansion in the muddled versus the typical problem space. Policy change – or at least problem expansion – is more likely when conflict expands beyond the tight bounds of a dominant subsystem (Schattschneider 1960; Cobb and Elder 1983; Baumgartner and Jones 1993). Cobb and Elder linked ambiguity with problem expansion (1972, pp. 111-115). Using the terminology of the characteristics of the muddled space in Table 2.2, the greater the number of issue attributes associated with a problem, the greater the likelihood it attracts a broader range of subsystems. Cobb and Elder also note an important tradeoff regarding problem expansion of complex (i.e., ambiguous) issues: A high degree of ambiguity (attribute diversity) may prevent specific solutions from being seriously considered (1972, p. 115). Put another way, even when the definition of a policy problem more accurately reflects the "true" nature of its cause and effect relationships, its solution sets may be far from comprehensive.

We know that news organizations index coverage to elite conflict (Bennett 1990; 1996, 2003; Lawrence 2000; Bennett, Lawrence, and Livingston 2007). Subsystem conflict in the muddled space is more protracted than in the typical problem space. The

theory of media signaling on complex policy problems suggests that news coverage of conflict over issue attributes and causal relationships will facilitate problem expansion, as it presents opportunities to and pressure on subsystems to better clarify and understand the problem. Or in the case of climate change, opportunities to argue that there is no problem. But because of its complexity and because the certainty of its causal linkages is a fixed feature of debate, news coverage that amplifies this uncertainty will steer debate away from comprehensive solutions sets to a more narrow, contained set.

Summary

This chapter provides a theory of media signaling in muddled problem spaces that characterizes complex policy problems. The contributor and conduit traditions of media influence are combined to understand how coverage that indexes to elite debate over public affairs is meaningful in terms of policy agenda dynamics. News coverage shapes policy debates over problem uncertainty and severity by sending signals that structure subsystem competition and conflict in the muddled problem space. This approach to media influence emphasizing the importance of signaling is undergirded by core components from the information-processing perspective of policy change. These components are attention limits and prioritization, disproportionate information-processing, positive and negative feedback cycles, and the attribute diversity and causal uncertainty inherent in complex policy problems. The theory of media signaling is tested on one of the most complex, diabolical problems of our time – climate change (Stephen 2011). The next chapter on research design introduces three aspects of news coverage that shape policy debates about climate change in the muddled problem space – attribute diversity, causal uncertainty, and volume. The theory of media signaling is tested using two aspects of the problem definition process – problem prioritization and solution generation. The chapter on research design discusses the indicators used for

prioritization, solutions, and the three aspects of climate news coverage. It provides information on data collection and policy content coding, as well as expectations for media signaling on prioritization and climate alternatives that lead to problem expansion and solution containment.

Chapter 3: Problem Expansion and Solution Containment

> [T]his greenhouse effect is now a major concern of Members of the Congress and of the people everywhere in this country. The question is what do you do about it. Well, the first thing you do about it is learn about it, what is happening, why is it happening, how serious is the problem. Then we must begin to address this very serious problem.[20]
>
> *Sen. J. Bennett Johnston, June 23, 1988*

This statement by Senator Johnson in 1988 was made on the same day – at the same hearing – when NASA climate scientist James Hansen told Congress with "ninety-nine percent confidence" that "the greenhouse effect has been detected, and it is changing our climate now".[21] This statement, which was widely covered by the media, "ignited a firestorm of public debate, and elevated the carbon-dioxide problem to pre-eminence on the environmental agenda ever since" (Sarewitz and Pielke 2000). Fast forward nearly twenty years to 2007 and Sen. Johnson's question of "what do you do about it" was still a matter of contentious debate. This is because the "what is happening", the "why is it happening", and "how serious is the problem" became major sticking points in defining the climate problem for over two decades. Remarks from Members of Congress at hearings in 2007 provide a glimpse at the opposing viewpoints of how climate change was understood, how it should be addressed, and how prepared policymakers were – and still are – to address it.

[20] Greenhouse Effect and Global Climate Change, House, 100th Cong., 1988.
[21] *Ibid*

> We know what we have to do in order to avoid the worst effects of climate change. …. [W]e need to cap and eventually significantly reduce our greenhouse gas emissions. … Now, we must face the challenge of global warming. I believe it is one of the greatest challenges of our generation.[22]
>
> *Sen. Barbara Boxer (D-CA), January 30, 2007*
>
> Your Inconvenient Truth spends a lot of time discussing the problem, but little time detailing solutions… .[23]
>
> *Sen. Christopher S. Bond (R-MO), March 21, 2007*
>
> Even the mainstream media … are now noticing that global warming science is uneven and evolving. We need to be deliberative and careful when we talk about so-called scientific facts.[24]
>
> *Rep. Joe Barton (R-TX), March 21, 2007*

Climate change has been on the congressional agenda for nearly three decades. Not for lack of trying, they have been unable to pass comprehensive climate legislation, such as cap-and-trade or a carbon tax. Bypassing Congress, President Obama in 2013 directed the EPA to work with states to develop a plan to reduce carbon emissions from new and existing power plants.[25] However, the climate change debate is far from settled. In 2016, more than two dozen states and multiple industry groups were able to stave off implementing the EPA's Clean Power Plan while it undergoes judicial review (Adler 2016). Arguably one of the Republican's more moderate candidates for the presidential nomination, Ohio Gov. John Kasich, believes of climate change that "[w]e don't know how much humans actually contribute, but it is important that we develop renewables" (Sheppard 2016).

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[22] Senators' Perspectives on Global Warming, Senate, 110th Cong., 2007.
[23] Vice President Al Gore's Perspective on Global Warming, House, 110th Cong., 2007.
[24] Perspectives on Climate Change, House, 110th Cong., 2007.
[25] https://www.whitehouse.gov/the-press-office/2013/06/25/fact-sheet-president-obama-s-climate-action-plan

Why has the U.S. government been so slow to respond to climate change with comprehensive solutions? Why do we see so much congressional debate on the climate problem, but only mostly incremental movement toward solutions? How it is that high-profile public figures can question basic scientific tenets of global warming and climate change on which 97% of climate scientists agree (Cook et al 2013; Cook et al 2016)? One explanation rests on how it has been covered in the news. As shown in previous sections, there is a proverbial cottage industry of studies that connect climate news coverage to elite debate and scientific controversies, suggesting it as a source for policy stagnation. Despite this wealth of scholarship, the media-government connection remains largely untested (for an exception, see Lui et al 2011).

This dissertation project presents a theory of media signaling about complex problems to policy communities and applies it to the case of climate change. News coverage helps shape the climate debate. We see mostly protracted deliberation around the problem definition and limited solutions applied to it due to three characteristics of climate news coverage – attribute diversity, causal uncertainty, and volume. These aspects of climate coverage helped create and perpetuate the muddled problem space in which most policymaking activity on climate change takes place most of the time. News coverage mediates the muddled space by amplifying uncertainty surrounding its attributes, causal relationships, and its impacts. This triggers competition and conflict among those in the policy community – and those trying to become part of the policy subsystem – over how to steer the climate debate.

What news coverage does is it helps elevate the importance of the problem. It organizes attention, induces subsystem competition and conflict over which set of attributes define climate change, and it moderates disputes over its causal relationships. It is in this sense that media signals are forces for positive feedback; which is to say, they

facilitate problem expansion. Focusing attention and devoting resources to better understand how to characterize it is part and parcel of problem expansion. But this growth is also a delimiter for which set of solutions are considered to solve the problem. The nature in which attributes and causal relationships are covered in the news leads to heightening already intense climate change debates about problem uncertainty – its scope, why it happens, and its impacts. In light of so much unsettled uncertainty, the solutions are limited to those that do not have as much consequences for resource allocation, government intervention, and regulation. It is in this sense that news coverage of climate change contains – limits – solutions, and is a negative feedback force slowing down momentum for large-scale policy change.

The remainder of this chapter is organized as follows. The three aspects of news coverage – attribute diversity, causal uncertainty, and volume – and the dependent variables used to gauge policy debates in the muddled space – problem prioritization and climate solutions – are introduced and described. The expectations for the relationship between news coverage and these policymaking activities are presented, along with the expected influence of disproportionate information-processing and party influence on climate debates. Following this, I provide a detailed accounting of the measures, data collection, and policy content coding methodology used to test the theory of media signaling.

RESEARCH DESIGN

Problem expansion and solution containment: This is how news coverage shapes the complex and highly politicized scientific problem, climate change. It grows the problem, but limits its solutions. Because of climate news, the problem is attended to, better understood, and grows more complex in the attributes used to define it. But

characteristics of coverage also mean its attributes, causal relationships, and arguments about problem severity are imbued with uncertainty and in near-constant dispute. This limits the scope – in terms of comprehensiveness – of solutions deemed necessary and politically feasible used to solve it. To test the theory of media signaling presented in chapter 2 and explicated subsequently, this dissertation focuses on two aspects of subsystem activities around the problem definition process: prioritization and solution generation. Support for problem expansion and solution containment is derived by examining the relationship between characteristics of climate news – attribute diversity, causal uncertainty, and volume – for each of these aspects of the problem definition process.

Media Signals on Climate: Attribute Diversity, Causal Uncertainty and Volume

We now turn to a brief review of the characteristics of climate coverage that steer subsystem competition and conflict over problem definitions in the muddled space. Table 3.1 provides descriptions of the main independent variables of interest – attribute diversity, causal uncertainty, and volume. Attribute diversity is ambiguity in the variety and concentration of the dimensions found in climate change news coverage. These are media signals that – when interacting with the muddled problem space – amplify problem uncertainty in climate policy debates. Problem uncertainty is understood as doubt over the veracity of which attributes characterize the climate problem definition. Attribute diversity in climate coverage can lead to competition among policy communities in light of a problem definition that is ambiguous and unstable.

Table 3.1: Three Media Signals of Climate Change News Coverage

Media Signal	Description
Attribute Diversity	Ambiguity in the variety and concentration of the dimensions found in climate change news coverage. This leads to amplifying problem uncertainty.
Causal Uncertainty	Reporting on the uncertainty in the causal relationships that link human behavior with global warming, global warming with climate change, and climate change with its impacts. This leads to intensifying disputes over causal stories and problem severity.
Volume	The amount of attention the media devotes to climate change. This increases the salience and importance of the climate problem.

The second media signal is causal uncertainty. Causal uncertainty is reporting on the uncertainties in causal relationships that link human behavior with global warming and global warming with unwanted climate change consequences, such as population displacement from sea-level rise. This media signal interacts with the muddled problem space to intensify existing disputes over causal stories and problem severity. To borrow from Sen. Johnson's quote at the beginning of the chapter, it delineates arguments over "what is happening" and "why is it happening" and "what are its effects." Recall what Rep. Smith's (R-TX) said about causal uncertainty in his op-ed in *The Hill*:

> Climate change is due to a combination of factors, including natural cycles and human activity. But scientists still disagree about how much each of these factors contributes to the overall climate change the Earth is experiencing. But understanding the causes of climate change is critical to developing a serious and effective solution.[26]

The third media signal is volume. Volume in news coverage is the amount of attention the media devotes to climate change. When this signal interacts with the muddled space, the climate problem increases in salience, and hence importance. We see this quite often in studies of media influence on policy agenda setting (Baumgartner and

[26] Rep. Lamar Smith (R-TX) in *The Hill*, October 1, 2013. http://the hill.com/opinion/op-ed/325971-extreme-weather-isnt-linked-to-climate-change. (Accessed November 2013).

Jones 1993; Jones and Baumgartner 2005; McCombs 2008; Van Alest and Walgrave 2006). Policy communities may react to this signal with an increased sense of urgency in terms of defining the climate problem – to better understand it and to come up with a set of feasible solutions to address it.

Problem Prioritization and Solution Generation in Climate Policy Debates

The climate problem must be prioritized in order to begin to understand it and to start considering which set of solutions is best-suited to solve it. The theory of media signaling in the muddled space suggests that news coverage will influence problem prioritization and solution generation. Table 3.2 shows how problem expansion and solution containment are linked to integral parts of the policy process, prioritization and solution generation, which lead to policy change. The indicators for prioritization and climate solutions are listed in the right-hand column of the table.

Table 3.2: Media Influence and Indicators of the Policy Process

Media Influence		**Policy Process**	**Indicator**
Problem Expansion	→	Prioritization	Hearings Opening Statements
Solution Containment	→	Solution Generation (Policy Change)	Large-Scale Solutions Incremental Solutions

The indicators of prioritization and solution generation are all measured using congressional hearings, which are a forum for generating information on policy problems and solutions. They are the locus of subsystem competition and conflict over defining problems and delineating their solutions (King 1997; Worsham 1997; Baumgartner, Jones and MacLeod 2000; Jones and Baumgartner 2005). Prioritization of climate change in policy debates is linked to media signals playing an integral role in problem expansion. Congressional hearings and opening statements made by Members of

Congress at these hearings are both indicators of policy communities prioritizing the climate problem. Solution generation – as a precursor to policy change – in climate debates is linked to media signals influencing solution containment. As a reminder, solution containment occurs when incremental approaches to fixing the climate problem are preferred over more costly comprehensive solutions. Large-scale solutions (such as cap-and-trade) and incremental solutions (such as energy efficiency) to reducing greenhouse gas emissions are used as indicators of climate solution generation.

Expectations

This section provides the expectations for how news coverage influences climate problem prioritization and solution generation. It also provides expectations for the expected effects of disproportionate information-processing and party differences in the climate change debate. Each set of expectations is accompanied by a discussion of the mechanisms and theoretical reasoning that underpins them. The theory of media signaling is about how aspects of climate news coverage sometimes encourages debates, and at other times, discourages them. Since this is the case, the expectations provide the predicted direction of news effects on prioritization and solution generation.

Prioritizing the Climate Problem: Hearings

As Sen. Johnson noted in the above statement, in order to solve problems, you must learn about them – you must first define the problem at hand. This requires the prioritization of attention and other resources, including political capital. Chapter X looks at two indicators of problem prioritization – prioritization via congressional agenda setting and competition among policy brokers. In order for a problem to be recognized, it must be prioritized. Efforts to define a problem also require it to be prioritized. From the information-processing perspective, prioritization is the result of detecting and

categorizing information about a condition or an existing policy problem (Jones and Baumgartner 2005).

The muddled problem space in which climate change resides is characterized by an oversupply of information from diverse sources, such as scientists, industry groups, think tanks, advocacy groups, federal agencies, and even multiple congressional committees. The theory of media signaling argues that news coverage steers the allocation of attention in such a messy information-rich environment. In terms of agenda setting, or institutional prioritization related to problem recognition, the below expectations about climate news coverage should hold. As a reminder, hearings are used as an indicator of institutional prioritization.

> 1: The number of hearings will increase with attribute diversity and volume of news coverage because they are media signals that focus subsystem attention and mobilize competition over problem definition in light of problem uncertainty and importance.
>
> 1a: The number of hearings will decrease with causal uncertainty because it heightens disputes over causal stories, making it less likely that the policy community will recognize the climate problem as one that warrants debate.

Congressional problem prioritization – holding hearings in this study – is the frontline of attention allocation to the problem definitions process. Committees will call hearings in response to changes in climate coverage of attribute diversity because it sends signals to subsystems that the attributes that define the problem are unstable. This increases the likelihood of conflict expansion. Regarding the climate science signal, as discussed previously, causal stories are integral to agenda setting (Stone 1988, 1989; Rochefort and Cobb 1994). Strong signals from the media that causal relationships are uncertain will dampen agenda setting effects of news coverage. Finally, media attention has been shown time and again to be positively associated with congressional problem prioritization (Baumgartner and Jones 1993; Cobb and Elder 1972; for a review see Van

Aelst and Walgrave 2006) because it elevates the visibility of the problem outside the confines of closed subsystem policymaking.

Prioritizing the Climate Problem: Opening Statements

Competition to define the climate problem via opening statements made by Members of Congress at hearings is the second form of prioritization examined in this dissertation. Whereas congressional prioritization captures how political institutions (and policy communities as collectives) respond to news coverage, this looks at how individuals within policy communities respond. This is also prioritization of the problem *after* it is on the agenda. As discussed, subsystems compete over the definition of problems in order to pursue their policy goals. Members of Congress are considered high-profile policy brokers for competing subsystems (Sabatier and Jenkins-Smith 1993; Kingdon 2003). Opening statements are a vehicle for casting an image over and making claims about a policy problem[27]; it is used to steer debate. Chapter 4 provides several examples of opening statements where Members used news stories of climate change to support or oppose allocating resources to the problem. The theory of media signaling suggests that:

> 2: The number of opening statements will increase with all three aspects of news coverage – attribute diversity, causal uncertainty, and volume – because they will induce policy brokers to compete over defining climate change in light of problem uncertainty, heightened scrutiny of problem seriousness, and increases in importance.

News coverage of attribute diversity provides an opportunity to compete over which attributes define the climate problem. Because the agenda is already set – there is a degree of consensus that the problem warrants attention – causal uncertainty in news

[27] Sherrod Brown, in his book *Congress from the Inside* writes that opening statements are used to "bring out a point or clarify an issue." (2004, p. 38)

coverage is expected to have a positive effect on the number of opening statements. There are several ways this can happen. Proponents will react to the overemphasis on scientific uncertainty by stating as such, arguing that there is far more clarity regarding the seriousness of the problem than what is reported in the news; or, they may cite it in a call for further research funding. Opponents will seize climate science in the news as a means to steer debate away from large-scale, resource-intensive solutions or toward nonproblemicity (McCright and Dunlap 2003). The volume of coverage should have a large effect because it increases the salience of the problem to the wider issue public. As it is submitted to the record, it is a statement of policy position.

Climate Solution: Large-Scale and Incremental Policy Change

The generation of solutions is the second feature of the policy process examined in this project. As you may recall, a problem definition is a set of causal relationships that structures its solution sets, is solvable, and is *worth* solving (Newell and Simon 1972; Dery 1984). Chapter 6 is devoted to looking at how news coverage structures the generation of solutions in climate debates. The argument is that climate news can be understood as a mechanisms for solution containment by shifting debate away from comprehensive solutions and toward incremental approaches to fixing it. Incremental and large-scale solutions for tackling climate change have been part of the congressional agenda for nearly three decades. Even so, the House and Senate have only seriously considered a handful of comprehensive cap-and-trade climate bills, and not one has passed both chambers. Instead, climate legislation has been contained to incremental approaches, such as funding research, technology R&D, energy efficiency, conservation, alternatives, and renewables. Often, these types of solutions become provisions of major

energy bills, as opposed to being touted as climate legislation (e.g. Energy Policy Act of 1992 and 2005).

Many have pointed to climate news coverage as one of the reasons why the U.S. (and other countries) has been slow to move toward comprehensive solutions, such as Obama's 2015 Clean Power Plan (Boykoff and Boykoff 2004, 2007; Painter and Ashe 2012; Antilla 2005; Zehr 2000, 2009; Oreskes and Conway 2010; Pielke 2010; McCright and Dunlap 2003). However, the literature does not directly test this relationship. What is it about news coverage that often prohibits the feasibility of large-scale solutions, yet encourages debate of incremental approaches to solving the climate problem? The theory of media signaling presented in this dissertation implies that in regards to large-scale solutions:

Large-Scale Solutions

3: Large-scale solutions in policy debates will decrease with attribute diversity and causal uncertainty in climate news coverage because these media signals amplify problem uncertainty and highlight disputes over the seriousness of the problem, respectively. This reduces the political feasibility of comprehensive approaches to fixing the climate problem.

3a: Large-scale solutions will increase with the volume of coverage because it signals growing importance of the climate problem, which encourages policy debates on fixing it.

Incremental Solutions

4: Incremental solutions will increase with attribute diversity and causal uncertainty in climate coverage because media signals that amplify problem uncertainty and disputes over severity will increase the political feasibility and policy tool appropriateness of smaller-scale solutions.

4a: Incremental solutions will decrease with volume of news coverage because the signal of importance will shift debates to considering solutions far greater in scope and potential effectiveness.

Boydstun (2013) demonstrates that attribute diversity in news coverage begets increases in attribute diversity in subsequent news cycles in the cases of terrorism and the death penalty. Liu et al (2013) show that news coverage of climate solutions increase when coverage is linked to outside issues such as the economy and especially energy. In their study, climate solutions decrease when coverage is linked to climate science (which they found in 50% of their cases). Both of these studies are media-centric – they do not test whether attribute diversity or issue dimensions in coverage affect policy debates, nor do Liu et al parse incremental from large-scale solutions.

When attribute diversity grows in news coverage it sends a signal to policy communities that the climate problem definition is losing its integrity and potentially changing. Large-scale solutions to climate change such as cap-and-trade require massive shifts in resource allocation, government intervention, and regulation. It requires support from a broad coalition of interests – agriculture, defense, energy industry, manufacturers, business, environmental groups, and so on – herculean coordination and bargaining. If the problem definition is not stable, support breaks down and pressure to come around fades. This is why coverage of attribute diversity – because it heightens problem uncertainty – should be negatively related to large-scale, punctuated changes.

Attribute diversity in the news should be positively associated with incremental solutions because it limits the scope of politically-feasible solutions. This relationship should hold also because these signals of problem uncertainty can open up windows of opportunities for existing solutions to be attached to climate problems, a la the garbage-can approach to problem-solving (Kingdon 2003; Cohen, March, and Olsen 1972). We see this anecdotally in Sen. Wirth's suggestion that advocates of energy conservation "ride the global warming wave" (Stanfeld 1988) and in news coverage and elite debate

that frames incremental solutions such as energy efficiency as "business opportunities" (Zehr 2009).

Causal uncertainty in news coverage should have a dampening effect on comprehensive solutions in policy debates about climate change, as Liu et al (2013) found with solutions in the media in general. However, it should have the opposite effect on incremental solutions. Remember that this dissertation captures solution generation during hearings debate – when the issue is already on the agenda. Causal uncertainty in the news will have a positive impact here because media signals heighten uncertainty in how actions are linked with consequences – thus calling into question problem severity. This provides opponents of comprehensive solutions the opportunity to argue that an incremental approach to policymaking is more justified, given the uncertainty in why climate change happens and what its impacts are. We see this in the example at the beginning of the chapter with Gov. Kasich in 2016 calling for renewables in light of uncertainty in the human contribution (Sheppard 2016).

Disproportionate Information-Processing

Humans and organizations – and especially political institutions – are disproportionate information-processors (Jones and Baumgartner 2005; Jones 2001). Restrictions on cognitive and capacities, coupled with institutional design, leads to over- and under-reacting to information signals. That is, information may not be processed and reacted to at the same speed in which it is produced. The logic of media signaling suggests that there could be threshold effects associated with how policy debate shifts as a response to news coverage, leading to:

> 5: Threshold effects for climate news signals will vary by coverage type and stage in the problem definition process.

Party Control

One of the reasons given for the lack of a national climate policy for so many years is that it quickly become a partisan issue, opposed by conservative lawmakers, think tanks, and corporations (McCright and Dunlap 2000, 2003; Fisher et al 2013; Jatkoswi and Nowlin 2014; Park et al 2010; Oreskes and Conway 2010). This leads to:

> 6: Republicans should be less active in the problem definition process save for giving opening statements at hearings to highlight its uncertainties and/or steer debate towards "nonproblemicity."

Summary

This chapter explicates the problem expansion and solution containment argument based on the theory of media signaling, and specifically, to climate change. News coverage elevates the climate problem. It organizes and prioritizes policy attention. It activates competition and conflict over which attributes define climate change in policy debates. It also moderates disputes over causal relationships that are used by policy communities to advocate for either limited or comprehensive solutions. The nature of news coverage – the three aspects attribute diversity, causal uncertainty, and volume – heighten already intense debates over the climate problem. The nature of news coverage also increases existing uncertainties about climate change. In light of so much unsettled uncertainty, news coverage limits climate solutions to those that do not have as many consequences for resource allocation, government intervention, and complicated regulatory regimes.

This dissertation looks at how news coverage influences problem prioritization and solution generation in policy debates. This maps back onto problem expansion and solution containment, respectively. The theory of media signaling suggests that policy communities as a whole will prioritize the climate problem as attribute diversity and

volume of news coverage grows. Policy communities will be less likely to prioritize the climate problem as a whole, however, as causal uncertainty in news coverage increases because its severity and need of government redress will be called into question. The theory of media signaling also implies that policy brokers acting on behalf of policy communities will respond to all three media signals once the climate problem is on the policy agenda – an arena in which conflict and competition are already at elevated levels.

On climate solutions and their containment, the theory of media signaling suggests that large-scale climate solutions in policy debates will decrease with attribute diversity and causal uncertainty in news coverage because these signals amplify problem uncertainty and highlight disputes over how severe are the climate impacts. But volume of coverage should have the opposite effect – it should increase large-scale solutions because its signals the growing importance of fixing the climate problem.

We should see completely different dynamics for the relationship between news coverage and smaller-scale solutions to fixing the climate problem. The theory of media signaling implies that more limited, less costly approaches should become more prominent in policy debates with increases in attribute diversity and causal uncertainty in climate news coverage. This is because these media signals increase the political feasibility and policy tool appropriateness of these smaller-scale alternatives in light of high levels of problem and causal uncertainty. However, as with large-scale climate fixes, volume should have an opposite effect because the signal of importance will shift debates away from less effective solutions toward either comprehensive approaches or efforts to better understand which set of attributes best defines climate change.

These questions are addressed in Chapters 5 and 6 with four dependent variables that capture problem prioritization and climate solutions in policy debates. The next part of the dissertation, Chapter 4, provides a thorough accounting of how the three media

signals under investigation – attribute diversity, causal uncertainty, and volume – should elicit a reaction from policy communities. It addresses how they are manifested through journalistic practices that shape reporting on public affairs. And it provides a detailed discussion of how these media signals are indexed to climate events, elite conflict and policy debates, and scientific controversies

Chapter 4: News Coverage of Climate Change, 1987-2012

This chapter provides a detailed examination of the three aspects of climate change news coverage that produce media signals in the muddled problem space where policy debates take place. Here, volume will be addressed first, attribute diversity second, and causal uncertainty third. This chapter is organized into three sections, one for each media signal. Each section is made up of three components: (1) the relationship between the media signal and subsystem responsiveness; (2) the journalistic practices behind the media signal; and (3) an exploration of how that signal appears in the content of climate news.

The first section asks, what drives news coverage of climate change? Engaging in this question necessarily requires an understanding of the journalistic standards and practices and the economic constraints of media organizations that feed into covering complex, scientific policy problems. This section incorporates the conduit tradition in political communications to explain how increases in the volume of news coverage are triggered by – and indexed to – events, elite conflict, and scientific controversies (see Table 2.1). The second section on attribute diversity lays out what attribute diversity in climate news looks like, where it comes from, and how it structures policy debates. The third section explains how news coverage of climate science produces an overemphasis on causal uncertainty that heightens disputes over what causes climate change and what are its impacts.

VOLUME OF CLIMATE NEWS

One of the three media signals under investigation, volume of climate news is the amount of attention the media devotes to climate change. Growing climate coverage is a

signal to policy communities that the salience and importance of the climate problem is increasing.

Media Attention and Subsystem Responsiveness

Chapter 2 introduced a theory of media signaling based on the information-processing perspective to understanding the policy process. This theory approaches media influence in terms of attention dynamics, in line with the contributor literature outlined in Table 2.1. As previously identified in Table 2.2, climate change in the muddled problem space is characterized by an oversupply of information, multiple ill-defined attributes, causal relationships that are uncertain and disputed, contention surrounding severity of the problem, boundary-spanning competition, and protracted conflict. This creates a messy policy environment in which subsystems involved in the climate problem operate. Media attention is one of a several important inputs into the system that directs the allocation of attention and organizes subsystem activity in the muddled problem space.

Changes in the volume of climate news coverage are signals to the policy community that the existing problem definition is unstable and marked with uncertainty. The theory of media signaling predicts that subsystem participants should respond to these signals by increasing activities that are related to the problem definition process. News coverage should facilitate competition and conflict over the attributes and causal relationships that structure the boundaries of the problem. Advocates and opponents of government action on climate change can utilize media attention as windows of opportunities to pursue their goals by steering debate in their desired direction.

How has climate change been covered in the news and attended to by subsystems in the United States? Figure 4.1 displays a quarterly time series of combined climate

coverage by *The New York Times* and *The Washington Post* and congressional hearings from 1987-2012.

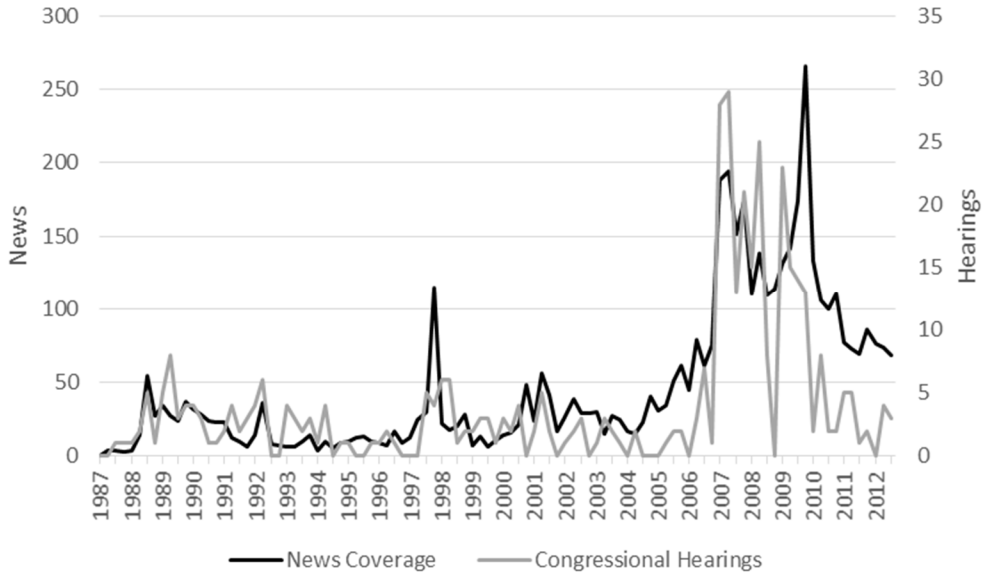

Figure 4.1: Climate Change News Coverage and Congressional Hearings (Quarterly) 1987-2012

In line with previous scholarship, we see climate change emerge on the media's agenda as an uptick in coverage in the latter months of 1988. After that, we also see increases in coverage in 1992, 1997, 2001-2002, and two large increases in 2007 and late 2009 through early 2010. This is also consistent with studies of how news organizations have covered climate change over the years (Ungar 1992, 1995; McComas and Shanahan 1999; Boykoff and Boykoff 2004, 2007; Liu et al 2011, 2013; Zehr 2000, 2009; Painter and Ashe 2012). The number of congressional hearings increased those years as well, save a slight 10% decrease in 1992 and no changes in 2001 and 2002. The theory of media signaling expects a lag between media attention and subsystem responsiveness. Hearing activity increased the year following the upticks in news coverage for all years

except 2007 and 2009.[28] Of note, climate coverage is a consistent feature of the media's agenda. This is not the case for the congressional hearing agenda. There are 18 null time points in the hearings data series, but none for news coverage.

Journalistic Practices and Climate Coverage

This section provides an overview of the journalistic norms, standards, and newsroom imperatives that explain what drives climate news coverage. The following factors explain what makes climate change newsworthy: events, novelty, dramatization, routinized reporting of complex scientific issues, elite conflict, and scientific controversy. In accordance with the conduit literature, elite conflict and scientific controversy -- which are not mutually exclusive -- are the fundamental drivers of media attention to climate change. The lengthier proceeding section that focuses on periods characterized by large increases in media attention provides further detail of and context to how journalistic practices, elite conflict, and scientific controversies interact to carve out agenda space for climate news.

The nascence of climate coverage as a mainstay of the media agenda is at around the mid-to-late 1980s (McComas and Shanahan 1999; Boykoff and Boykoff 2004, 2007; Wilkins 1993; Trumbo 1996; Unger 1992, 1995; Mazur 1998). In a context of increasing attention to similar environmental problems such as acid rain, ozone depletion, and species extinction (Mazur 1998; Dunlap 1991), the confluence of a few events propelled global warming onto the media agenda in the Summer of 1988 (Boykoff and Boykoff 2004; Mazur 1999; McComas and Shanahan 1999). On June 23, 1988 the Senate held a hearing on climate change during a heat wave on the same day that also happened to be the hottest temperature yet on record. In his testimony at this hearing, NASA scientist

[28] The correlation coefficient for the quarterly series is 0.75. Annual data correlate at 0.87.

James Hansen told members of the committee that his agency was "99% certain global warming had begun" (Shabecoff 1988, A1). Just a few days later, the fires in Yellowstone that raged in drought conditions were covered as an example of one of many consequences of the greenhouse effect (*New York Times* 1988, 4.1). On the other side of the equator, massive plumes of smoke from burning rain forest in the Amazon were linked to global warming, its destruction "may account for at least one-tenth of the global man-made output of carbon dioxide" (Simons 1988, A6).

What are the journalistic practices that drive news coverage of climate change? First, we turn to how triggering events attract media attention. As the saying goes, if it bleeds, it leads. There is a large role for events in the newsmaking process (Dearing and Rogers 1996; McCombs 2004). The harmful and sometimes very visible consequences of global warming and climate change trigger news coverage (Unger 1992, 1995; Liu et al 2008, 2011, 2013). Real-world events such as these fires, and hurricanes and other natural disasters, are newsworthy also for their timeliness (i.e., newness) and impact (Gans 1980; Tuchman 1978). But events need not be dramatic on their face like natural disasters in order to gain news coverage. Novelty can be extended to changes in the indicators used to track a policy problem, often in the form of international conferences and the release of scientific reports. For instance, McComas and Shanahan (1999) found that approximately 80% of the articles in their study presented new evidence or research from scientific and government reports.

One of the challenges facing science and environmental reporters is that the causes of global warming and climate change are complex and often invisible (Wilson 1993; Wyss 1991). Journalists overcome this problem with routinized reporting (Tuchman 1978). They link a complex, somewhat amorphous subject to concrete events and to policy areas with built-in audiences, such as economics and energy (Fitts 2014). In

fact, Liu et al (2008, 2013) find that the majority of news coverage on global warming and climate change is thematic and linked to many policy issues – it is presented in a broader context than the triggering event from whence it came (but see Boykoff and Boykoff 2004, 2007).

The news value of an event highlighting a policy problem such as global warming grows if it can be tied to elite conflict and controversy (Bennett 1990, 1996, 2002; Boykoff and Boykoff 2003, 2007; Boykoff 2011). In fact, instances of elite conflict and controversy for all intents and purposes *are* events in covering public affairs. News coverage of global warming and climate change increases "when climate science meets politics" (Boykoff and Boykoff, 2007). Indeed, using elites as sources and indexing to political and scientific conflict is a hallmark of climate change news coverage (Shesheta and Hopmann 2012; Zehr 2000, 2009; Mazur and Lee 1993; Trumbo 1996; McComas and Shanahan 1999; Boykoff and Boykoff 2003; Liu et al 2008, 2011). Indexing to elite debate is also a linchpin in the theory of media signaling presented in this dissertation project.

The uptick in coverage beginning in 1988 is in part attributed to real-world events. But journalists need to contextualize events. Climate coverage is first and foremost a product of elite sources and debates over of the scientific uncertainties related to climate change. The first IPCC assessment report was published in 1990 for the UN Framework on Climate Convention. In the Executive Summary to this report, which is written for journalists and policymakers, the IPCC stated they were *certain* that "emissions resulting from human activities … [will] enhance the greenhouse effect," resulting in an increase in the average warming of the Earth's surface. The summary also

went on to emphasize the many *uncertainties* related to predicting the "timing and magnitude" of climate change.[29]

At the same time, the US Congress in 1989 and 1990 held a series of hearings debating various provisions to reduce carbon dioxide emissions in proposed legislation related to the Clean Air Act amendments. However, none of these provisions were in the final bill, which passed November 14, 1990 and was signed into law shortly thereafter. Citing the many scientific uncertainties related to climate change, the policy community compromised to create the Global Change Research Program. This program was put in place in lieu of the more controversial proposals to reduce global warming, including limiting deforestation, developing alternative fuels, and fuel taxes (*CQ Almanac 1990* 1991).

Climate News Increases: Elite Conflict and Scientific Controversies

Elite conflict and debate underpinned by climate science controversies drive the increases in coverage we see in 1992, 1997, 2001-2002, and the two large increases in 2007 and late 2009 through early 2010. This section ties together subsystem activity and news coverage of climate change for each of these periods. Part of the theory of media signals presented in this dissertation project rests upon the conduit approach to the behavior and output of newsrooms. Climate coverage is by and large indexed to the parameters of elite debate, as we would expect regarding coverage of public affairs. However, as will be discussed in the subsequent section on climate science, the news does not mirror reality (Lippman 1922). The journalistic norms, practices, and economic imperatives that explain what drives media attention are also responsible for the production of news that is skewed from reality. Certain dimensions are covered more

[29] https://www.ipcc.ch/ipccreports/far/wg_I/ipcc_far_wg_I_spm.pdf. (Accessed February 2016).

than others and uncertainty in the policy community becomes amplified. Even though indexed to elite debate, media attention does not usually accurately reflect elite debate. It can downweight it, or it can overweight it. The theory of media influence based on signaling suggests that subsystems respond shifts in news coverage, as it helps them organize their priorities and elicits competition in problem definition.

1992: Earth Summit and Scientific Uncertainties

News coverage of climate change increased in 1992 by 27% from the previous year. This explanation for this uptick is rooted in novelty, conflict, and debate over scientific uncertainties (Boykoff and Boykof 2004, 2007). In order, the dominant dimensions of coverage that year were climate science with 28%, international affairs and cooperation at 25%, and energy and environment nearly tied with 15% and 14% respectively. Media attention steadily rose leading up to the UN Conference on Environment and Development in Rio de Janerio, Brazil (Earth Summit) in June. President Bush, who had called for the United States to participate in international conferences to address global warming on the campaign trail in 1988 (*Los Angeles Times* 1988), was reluctant to attend as his Administration had evolved to focus on the "vast economic consequences" of policy based on "rudimentary" science (*New York Times* 1989). In the end, Bush did attend; but, only after Congress passed resolutions urging him to do so (*CQ Almanac 1992* 1993). This high-level political conflict is fodder for news organizations.

The House and Senate held 10 hearings on climate change in 1992, focusing on the upcoming Earth Summit, strategies to control and the impact of greenhouse gas emissions, and several oversight hearings on the Global Change Research Program. Debate (i.e., statements) in these hearings centered on the status of climate science and the economic consequences of action versus inaction. For example, in his opening

statement, Representative Henry Waxman (D-CA) argued that the US could stabilize its carbon dioxide emissions to 1990 levels "at little or no cost" after noting that debate in the scientific community had moved on from whether warming will occur to debate over by how much and how quickly. In contrast, his counterpart on the committee, Rep. Ritter, warned against committing to major action, citing two university scientists' explanations for the shortcomings of predictive computer modeling. [92-H361-86, Waxman 1-2. Ritter 17-19].[30] In a hearing on Earth Summit negotiations, while an official from the DOE testified that regulations or a carbon tax were the only ways to efficiently and reliability reduce emissions, officials from the EPA and Commerce advocated for voluntary programs and technology transfers, emphasizing threats to competitiveness and opportunities for US businesses respectively, given "the current state of scientific knowledge." [92-H361-90, Volcansek].

Policy brokers such as Waxman see news coverage as opportunities to pursue their policy goals. In his statement he cites the urging from 10 top-tier newspapers' editorial pages – including the *Washington Post* and the *New York Times* – for US participation and leadership at the Earth Summit (*Ibid*). While this clear signal of support is used by policymakers such as Waxman to steer debate, opponents of mandatory and large-scale greenhouse gas emission reductions counter-mobilized by citing the lack of scientific certainty as one of the major obstacles to moving passed at most an incremental adjustment to the status quo. In this stance, the signal from the editorial pages was counterbalanced by the high volume of coverage that emphasized climate science uncertainty and the need for more research (Boykcoff and Boykoff 2007). For example, even though the editorial staff of the *Post* wrote in support of the summit, its reporters

[30] Pat Michaels at the University of Virginia and Dr. Richard Lindzen at MIT

also framed climate change in terms of a relatively new and still "fickle" science throughout the year (Weisskopf 1992, A1).

1997: The Kyoto Summit and the Science behind Global Warming Trends

In 1997, news coverage went up by more than three-fold from the previous year. As in the case before, media attention in 1997 was driven by events, elite conflict, and by debate over climate science. Activity relating to climate change by news organizations and policymakers increased leading up to the Kyoto Climate Summit. The Kyoto Protocol, signed by President Clinton but never ratified by the Senate, called for the US to reduce its greenhouse gas emissions to 1990 levels by 2012. Months before the summit, the Senate approved a bi-partisan resolution opposing the treaty, citing the absence of provisions to legally bind developing countries, including India and China, to similar emission reductions (*CQ Almanac 1997* 1998).

In terms of news coverage, 37% was devoted to aspects of international cooperation and developing nations' participation. Climate science, another point of conflict and controversy, accounted for 28% of reporting on the problem of global warming that year. Energy and the environment were at 17% and 8% respectively. The number of hearings on climate change in 1997 more than doubled from the previous year, with the Kyoto treaty the subject of over half of those hearings. One hearing was devoted to questioning the scientific basis for reducing greenhouse gas emissions, focusing on the state of predictive modelling and the ability to account for the human contribution versus natural variations of climate change. Other hearing topics included the use of biofuels and water management in light of an El Nino.

News coverage of climate science and international cooperation reflects several developments in the policy community as well as high-profile debates emanating from within it. A coalition of automobile manufacturers, business interests from the fossil fuel

industry, and unions formed in opposition to the treaty (*CQ Almanac 1997* 1998). This group spent over $13 million in a media campaign warning that the treaty would cause job losses, slow economic growth, and was based on premature -- if not incorrect -- scientific findings (Boykoff and Boykoff 2007; Oreskes and Conway 2010). Debates in the Kyoto and climate science hearings reflected this message with many members of Congress and expert witnesses drawing from news coverage to support their claims.

In House hearings on the Kyoto treaty, a representative from the Farm Bureau warned that emission reductions would result in higher fuel and hence food costs, arguing that both the scientific and policy communities were unsure that a climate change problem even existed.[31] Representatives from both the AFL-CIO and the National Association of Manufacturers cited the couched scientific language from the 1995 IPCC Second Assessment linking industrial activity and climate change as a reason to oppose the treaty on the basis of its threat to jobs, productivity, and competition.[32] Gilman (R-NY) did not question climate science in his opening statement to the Committee on International Relations. Rather, his support for reductions to 1990 levels hinged on the participation of developing countries, especially China. However, his colleague Rohrabacher (R-CA) was not circumspect on the state of climate science. In warning of a debilitating gas tax, he stated that "this idea of global warming, after keeping an open mind and trying to listen to the debate, is a lot of nonsense" because in previous hearings "scientists…on both sides of this, they ended up debating whether or not it was going to be global warming or global cooling over the next 20 years."[33]

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[31] Global Climate Negotiations: Obligations of Developed and Developing Countries, House, 105th Cong., 1997.
[32] *Ibid*
[33] *Ibid.* No scientists were on the witness panels in this hearing.

In the Senate hearing questioning the scientific basis for greenhouse gas reductions, three of the four climate scientists invited to testify stressed that they – the scientific community – lacked sufficient evidence to confidently link human activities with climate change.[34] Dr. Barron, a Professor in the Department of Geosciences at Pennsylvania State at the time, called for further research on climate change, pointing out that the uncertainties surrounding climate model predictions were still "very large". He went on to state that this was probably going to be the case for a while, predicting that 10 years in the future newspapers would continue to give a "balanced view," even if there still remains "substantial disagreement and controversy" among scientists.[35] News coverage of climate change was brought up again, this time by a Member of Congress. In his opening statement, Senator Bond (R-MO) quoted a *Washington Post* op-ed piece that "[t]he problem with global warming is that we don't yet know whether it represents a genuine national threat, and if so, how large," or whether a supposedly serious problem should be taken seriously at all (Samuelson 1997, A23).

2000 and 2001: Climate Science Events and the Kyoto Protocol Backlash

News coverage increased in 2000 and 2001 to nearly twice as much as the previous year. Media attention was driven by events, elite conflict, debates over climate science, and novelty. The agenda for 2000 and 2001 was dominated by two dimensions. For both years, climate science took up 36% and 24% of the media's agenda in reporting on climate change. Topics related to international cooperation came to 26% in 2000 and 41% in 2001. Two events directly related to climate science produced highly visible conflict in both the scientific and policymaking communities – and were covered

[34] Eric Barron from Penn State University; John Christy from University of Alabama, Huntsville; and Richard Lindzen from MIT in the hearing Global Climate Change, Senate, 105th Cong., 1997.
[35] Global Climate Change, Senate, 105th Cong., 1997.

extensively by news organizations. As for the other dimension, the Kyoto Protocol organized elite conflict and news coverage around international cooperation.

First, in August esteemed NASA climate scientist James Hansen, who testified in the 1988 hearings mentioned earlier, and some colleagues published a paper in the *Proceedings of the National Academy of Science*, the conclusions of which stirred controversy (Hansen et al 2000). As a *New York Times* reporter explained, Hansen et al wrote that the "emphasis on carbon dioxide may have been misplaced" and suggested that it would be more politically feasible to reduce global warming by focusing on other greenhouse gases (Revkin 2000, A1). This conclusion by Hansen and his coauthors was used by Republicans in subsequent hearings to question the need for the Kyoto treaty. The second event related to climate science was that a draft of the IPCC's Third Assessment was released in mid-October ahead of the Kyoto talks. In it, the panel of scientists said that there was a substantial role for human activity in global warming and that temperatures projections were higher than in the 1995 report (Revkin 2000, A22). The Kyoto Protocol, as it is otherwise known, was the subject of several congressional hearings.

As discussed earlier, novelty in a policy area can garner the interest of journalists and may increase the likelihood that it will be covered in a new dimension. This is what happened when in mid-October several large energy and manufacturing corporations – Dupont, Ford, Enron, BP, Weyerhaeuser to name a few – and the Environmental Defense Fund announced that they had teamed up to form the Partnership for Climate Action (Revkin 2000, C5). This group got ahead of Kyoto by pledging to voluntarily reduce their emissions of carbon dioxide, establishing a carbon trading regime among themselves, and by advocating for market-based and "green power" solutions to climate change (Drozdiak 2000, A18). The Kyoto treaty itself was the subject of "contentious high-stakes

negotiations" at the Convention on Climate Change in The Hague in December that year (Revkin 2000, A1). The biggest sticking point for the US was the carbon credits allotted for protecting existing forests and farmlands, and the negotiations "went down in flames" (Hammitt 2000, E01).

The events that triggered news coverage in 2000 are represented in political debate among members of the policymaking community that year as well. Congress held nine hearings[36] examining the Kyoto treaty (2), technologically-driven and market-based solutions (4), the science and complexities of climate change (3), and the carbon emissions associated with the increasingly popular Internet (1). Participants in these hearings link the remaining scientific uncertainties, especially in regards to its impact, to the need for solutions that were already being implemented by industry, such as carbon sequestration, CAFE standards, energy efficiency in buildings and appliances, and renewables such as wind and solar. This is of course in contrast to mandatory reduction limits, whether through cap-and-trade, regulations, or a carbon tax.

For example, in his opening statement in the hearing examining these solutions, Chairman McCain (R-AZ) said that they were "approaches to reducing greenhouse gas emissions, the *suspected* cause of global temperature increases" and reminded the audience about the uncertainties in and the complexities of climate science.[37] In line with the corporations that formed the Partnership for Climate Action, these "green energy" solutions were touted as business opportunities by witnesses and Members of Congress in this hearing and elsewhere.[38] The Senate also held a hearing on two legislative initiatives

[36] No change from the previous year.
[37] Solutions to Climate Change, Senate, 106th Cong., 2000
[38] Energy and Climate Policy Act and the Climate Change Energy Policy Response Act, Senate, 106th Cong., 2000.

(S. 882 and S. 1776) that would create an Office of Climate Change in the DOE to cost-share developing new green technologies with the private sector.[39]

In examining the science of climate change, a common message conveyed by both the elected officials and the researchers invited to testify was a call for more research to reduce significant uncertainties in climate science. Raymond Schmitt, Senior Scientist at Woods Hole Oceanographic Institutions, remarked on the challenges of modeling the role of the oceans in global warming and climate change: "…we are not doing a very good job at either modeling or predicting the role of the oceans…[we] do not yet have enough data.[40] In commenting on the draft IPCC report, Chairman McCain noted that some scientific evidence contradicts that climate change is real and due to human activity and that the report's findings highlight the need "for a more firm understanding and scientific consensus on global warming."[41] In a nod to the discord created by the reports, Chairman McCain proposed the creation of an alternative international commission of scientists to provide "unbiased sound scientific analysis to anyone in search of the facts on climate change."[42] His colleague on the committee, Senator John Kerry (D-MA), warned against "inserting politics into a scientific matter."[43]

The dynamics that triggered news coverage in 2000 carry over to explain a 39% increase in 2001. Events, novelty, dramatization, and elite conflict, and debate over climate science undergirded media attention to climate change. In 2001 there were multiple contentious international meetings on Kyoto, three high-profile scientific reports released, and President Bush reneged on a campaign pledge for mandatory carbon

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[39] *Ibid*
[40] Climate Change Impacts to the U.S., Senate, 106th Cong., 2000.
[41] Science Behind Global Warming, Senate, 106th Cong., 2000.
[42] *Ibid*
[43] *Ibid*

dioxide reductions. News coverage of climate science decreased by a third to 30%, while international cooperation increased by nearly two-thirds to take up 47% of the media's agenda space on climate change.

Responding to pressure from conservative lawmakers, the coal industry, and right-wing think tanks, President Bush announced in March that carbon dioxide would not be included in his proposal to regulate greenhouse gases (Adams 2001a). Bush also repudiated the Kyoto protocol, though he did say climate change was a "serious issue" (Boykoff and Boykoff 2007). Bush called for more research funding and further investment in green technologies instead, citing that a recently-released National Academy of Sciences (NAS) had found some scientific uncertainty on the causes and consequences of global warming (*New York Times* 2001, A12). Bush's announcement was met with strong condemnation by international leaders and by both liberal and moderate policymakers in the United States. News coverage steadily picked up momentum beginning in March and peaked in the summer months leading up to the World Conference on Climate Change in Germany and the G8 Summit in Italy in July.

During this window from March to July, the House and Senate held nine hearings on climate change, focusing on debates over climate science (5) and technology-driven solutions to reduce carbon emissions by increasing energy efficiency (4). Even with the change in Senate party control in early June when Jim Jeffords (I-VT) chose to caucus with the Democrats, debate centered on continued research and technological improvements as a policy responses in light of the uncertainty and variability that remained about the impacts of global warming.

Several of the hearings on climate science examined the findings from two NAS reports and the final version of the Third Assessment by the IPCC. In his opening statement, Senator Murkowski (R-AK) said of an NAS report, it is "not a call for action

but a call for improved climate monitoring and climate modeling."[44] When Senator Kerry (D-MA) remarked that they were moving from science to opportunities via policy solutions in a hearing on energy efficiency technologies, his Republican colleague countered with findings from an NAS report. Senator McCain (R-AZ) noted that there is still "considerable uncertainty in current understanding of how the climate system varies naturally and reacts to emissions of greenhouse gases and aerosols."[45]

News coverage during this period reflects the debate over climate science in the hearings. For example, in reporting on the IPCC's Third Assessment, the *New York Times* gave lengthy room to its opponents who argued that the IPCC "ignored the views of scientists who discount evidence of global warming as part of normal climate punctuations or cast doubt on the effects of carbon dioxide" (Smith 2001, A7). The *Washington Post* gave considerable space to the position held by S. Fred Singer, professor emeritus and frequently invited hearing witness, that the IPCC "grossly exaggerated the problem" and based it on "faulty models that don't conform to existing scientific data" (Pianin 2001, A16). In covering the release of an NAS report on abrupt climate change, both newspapers emphasized the variability and uncertainty in predicting such change and whether or not it should be considered threatening, because for example, "societies have demonstrated they are good at adapting to serious climate change" (Pianin 2001, A19).

2007: Policy Debates Intensify – Climate Science and Large-Scale Solutions

In 2007, news coverage nearly tripled in volume from the previous year, which is a more than fourfold increase in the amount as compared to 2001. As in the case of previous notable surges in media attention, the jump this year is attributable to novelty,

[44] Climate Change and Balanced Energy Policy Act, Senate, 107th Cong., 2001.
[45] Climate Change Technology and Policy Options, Senate, 107th Cong., 2001

events, dramatization, debates over climate science, and elevated political conflict among subsystem participants. The media's issue agenda was more evenly spread than prior periods with climate science at 27%, energy at 26%, and international cooperation at 20%. The total volume of news coverage peaked twice in 2007: once from February to late April and then again in September. These upticks in attention track with scientific and political events, debate over policy developments, and international conferences.

The period from February to late April was dominated by political conflict, climate science, energy sector policy solutions, and jurisdictional issues. After many years of Republican control, Democrats took over majority status of the House and Senate beginning in January, 2007. The Democratic leaders of both chambers, House Speaker Nancy Pelosi (CA) and Senate Majority Leader Barbara Boxer (CA), pledged to take on the issue of global warming (*CQ Weekly* 2007, January 22). We see congressional hearings on climate change increase over sevenfold from the previous year. Pelosi created the Select Committee on Energy Independence and Global Warming to organize the effort to prepare climate change legislation for the House (*CQ Weekly* 2007, January 27).[46] This raised the ire of not only many Republican House members, but also of fellow Democrats such as John D. Dingell (D-MI), Chairman of the Energy and Commerce Committee, who opposed sweeping legislation that would hurt his state's automobile industry (Eilperin and Grunwald 2007, A22; *CQ Weekly* 2007, January 22; Davenport 2007a).

Several events in the first quarter of the year related to the climate science debate heightened its visibility in news coverage and in the policy community. On January 30th

[46] The simple creation of this committee does not account for the marked increase in hearings from the previous year; rather, it is the product of changes in existing political, policy, and scientific forces. The House held 57% of hearings on climate change in 2007 and the Select Committee on Energy Independence and Global Warming held approximately 20% of the two chambers' total for that year.

the Union of Concerned Scientists and the Government Accountability Project issued a report alleging that the Bush Administration was interfering with the ability of Federal scientists to convey their findings (Dean 2007, A17). In early February, the IPCC released a draft of its Fourth Assessment Report's Summary to Policymakers and followed with portions of the report in subsequent months leading up to its adoption in May, 2007. The report concluded that, with 90% certainty, greenhouse gas emissions attributed to human activities accounted for most of the recent trends in global warming, as opposed to natural variations (Selin and VanDeveer 2007, p. 281). Writing that the earth was warming at an "alarming rate," a *Washington Post* article with the headline "Humans Faulted for Global Warming," highlighted warming's global effects: massive species extinctions," destructive rises in sea levels, and increased intensity and duration of hurricanes (Eilperin 2007, A23).

The House and Senate held several hearings on the allegations against the Bush Administration and many more to examine IPCC's findings from February through late April. They also held many hearings on several alternative cap-and-trade proposals, within which many participants tied the latest IPCC findings to call for strengthening climate change solutions.[47] At the same time, a proportion of news coverage and political debate contained language that casted doubt on the certainty of science and on the need for such large-scale policy solutions. For example, in their study on how the *New York Times* and *Washington Post* reported on the IPCC's Fourth Assessment during this time period, Painter and Ashe (2012) found that 18% of coverage contained the views of those who were skeptical of its findings. In a House hearing examining the IPCC findings, Representative Rohrbacher (R-CA) submitted to the record a list of scientists "who are

[47] Opening statements by Sen. Joe Lieberman (D-CT) and Sen. Barbara Boxer (D-CA) in Global Warming and Wildlife, Senate, 110th Cong., 2007.

not part of this 'so-called' consensus that any climate change is being caused by human activity" [2008-H701-65 2007, p 68] and proceeded to call a climate scientist "dishonest" multiple times as he was providing testimony on greenhouse gas emissions [ibid p .71].

Several additional dramatic and novel events related to debates about climate science and policy solutions explain the uptick in climate coverage at the front-end of the year. Former Vice President Al Gore and his documentary *An Inconvenient Truth* were the subject of contentious House and Senate hearings in March following its win of two Oscars in late February. Gore, who helped "reshaped public perception of what was once a wonkish scientific debate," was nominated for the Nobel Peace Prize in early February (Eilperin 2007, A1). It was awarded to him, along with the IPCC, later that year in October. In early April, the *New York Times* led with the story of the Supreme Court's 5-4 ruling on *Massachusetts v. Environmental Protection Agency*, "one of its most important environmental decisions in years" (Greenhouse 2007, A1). The Court ruled that the EPA not only had the authority to regulate greenhouse gas automobile emissions, it could not sidestep its authority to do so "unless it could provide a scientific basis for its refusal" (*Ibid*).

The House and Senate hearings featuring Gore in March were held to examine "disagreements over findings regarding responsibility of human activity for global warming and the extent of global climate change effects on the environment."[48] Gore and former Chairman Senator Inhofe (R-OK), who is often used as a news source because of his high profile (Painter and Ashe 2012; Shesheta and Hopmann 2012), engaged in a particularly heated debate on climate science. Inhofe asserted that "skeptics say science is not settled and alarmists say it is."[49]

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[48] Vice President Al Gore's Perspective on Global Warming, Senate, 110th Cong., 2007
[49] *Ibid*

In his question-and-answer period with Gore, Inhofe pointed to a *New York Times* article on a growing backlash against the former VP among supporters, which included NASA scientist Hansen criticizing his claims linking hurricanes to global warming (Broad 2007, F7). The article also included a quote from Roger Pielke, Jr. saying that Gore is a "very polarizing figure in the science community." Pielke, who is a professor and Director of the Center for Science and Technology Policy Research, University of Colorado, has testified numerous times in congressional hearings. The House hearing also featured Danish political scientist Bjorn Lomborg, a high-profile sceptic of climate change impacts. Dr. Lomborg, who has a column in the *Wall Street Journal*, appears often as a counterpoint voice in climate coverage (Painter 2011).

The second spike in 2007 news coverage started in September and lasted through to the end of the year. Several events, policy developments, and political debates during this time period exemplify news coverage that highlights energy and international cooperation dimensions of climate change, which took up 26% and 20% of the media's agenda that year respectively. In regards to international cooperation, several meetings took place leading up to the UN Conference on Climate Change in Bali in December. International climate conferences are routinely covered by news organizations. This year's had the added element of dramatization, similar to 2001. One schism that received a good deal of news coverage was the Bush Administration's decision to hold a climate summit at the White House in lieu of participating in talks that were held just a few days earlier at the UN (Boykoff and Boykoff 2007). A *Washington Post* editorial said that other countries' skepticism of the US was understandable, given that "Bush has temporized and dithered" (2007, A16). Another *Post* article highlighted the presence of Al Gore and California Governor Schwarzenegger in the stead of a delegation from the White House (Lynch 2007, A1).

In Bali, the Bush Administration attended again as an observer, declining to participate in anything other than open-ended talks due to its opposition over mandatory greenhouse gas emission reductions (Davenport 2007c). The Senate formed a bi-partisan albeit unofficial delegation to attend Bali. Though in the end, only Senator Kerry (D-MA) ended up making the trip. The rest stayed in Washington to debate the details of America's Climate Security Act of 2007 (S. 2191), a cap-and-trade bill co-sponsored by Senators Lieberman (I-CT) and Warner (R-VA) that was making its way through the chamber. Media outlets highlighted the tension between the parties showcased in Bali. For example, a *Washington Post* article quotes Senator Inhofe, who put out a statement that "Democratic attempts to influence the U.N. Climate Conference, much like the entire conference itself, are more theatrics than substance" (Eilperin 2007, B01).

The end of the year also culminated in several high-profile debates surrounding energy sector policy solutions, including the Warner-Lieberman cap-and-trade proposal. With Warner casting the sole Republican 'yay' vote, the bill barely made it out of the Committee on Environment and Public Works. As evidenced by hearing and floor debate, opposition arguments focused on potential job losses and increases in energy costs for the low-income (Palmer 2007b).[50] The *New York Times* and *Washington Post* also covered House cap-and-trade legislation (e.g. Eilperin 2007, A8), energy efficiency and fuel economy initiatives (e.g. Healy 2007, A22), and climate technology R&D (e.g. Wald 2007, H1) (see also Zehr 2009). Finally, a federal judge's ruling in favor of California's request to the EPA for a waiver to regulate greenhouse gas emissions received heavy media attention. An article in the *Post* led with a finding from a House Committee on Oversight and Government reform hearing on the matter that "[t]he Bush administration

[50] The bill was abandoned during the next session after prolonged floor debates prevented a floor vote (*CQ Almanac 2008* 2009).

has conducted a concerted, behind-the-scenes lobbying campaign to try to generate opposition to California's request to regulate greenhouse gas emissions from cars and trucks" (Eilperin 2007, A5).

Late 2009 to Early 2010: Large-Scale Solutions and Climate Science Scandals

The next period in the time series with a significant increase in climate news coverage occurred from September 2009 through February 2010, with a bump in media attention preceding it in late June and July. The total volume of coverage increased by 48% compared to the previous period, which is late 2008 through the first half of 2009. Some of the major issue attributes that define climate change shifted as well. Climate science increased by nearly a third to take up 30% of the media's agenda; energy decreased by a little under a fifth to 24%; and international attributes increased by a fifth to 20%. News coverage, as in previous years, was driven by elite debate, climate science controversy, novelty, events, and dramatization. Hearing activity decreased during this time period by 24%, which is mostly due to the drop in hearings from 23 to two in the first quarter of 2010 compared to the same time in 2009.[51] This is largely because comprehensive climate legislation had moved out of committee in both the House and Senate.

The first uptick in news coverage that occurred in June and July was driven by elite debate over climate legislation and international cooperation and trade. On June 26, the House narrowly passed comprehensive climate legislation for the first time, the American Clean Energy and Security Act (HR 2454). The bill, a cap-and-trade measure, limited greenhouse gas emissions to 17% of 2005 levels by 2050 using a system of buying and selling free and previously purchased allowances. It also included

[51] In fact, if we compare annual differences, hearings increased by 35% in 2009 compared to 2008.

requirements for the use of renewable resources by electric utilities and incentives for energy efficiency, and technology R&D (*CQ Almanac 2009* 2010). Debate leading up to the bill's passage centered on its potential effects on multiple business sectors and the economy in general, especially in light of uncertainty surrounding China's own emissions policies [2012-H361-91; Lewis June 8, 2008; Schatz June 15, 2009]. For example, seizing on an opportunity provided by news coverage, Representative Walden (R-OR) in an opening statement called attention to a *Washington Post* article that included a quote from a Peking University professor that "[b]oth sides are worried that the other side will take advantage of them on the climate change issue" (Eunjung Cha 2009, A27).

The *Washington Post* and *New York Times* indexed their coverage to elite debate throughout the legislative process, highlighting especially dramatic moments and points of conflict. For instance, in reporting on the final legislation, the *Washington* Post described Speaker John Boehner's (R-OH) attempt to filibuster a floor vote, which is a most unusual tactic in the House (Mufson, Fahrenthold, and Kane 2009, A1). In reporting on its passage, an opinion piece in the *New York Times* focused on climate science conflict, stating that of the "212 representatives who voted no…most rejected the bill because they rejected the whole notion that we have to do something about greenhouse gases" (Krugman 2009, A21). News coverage continued its increase through July as the Senate started to debate the House measure as they were formulating their own comprehensive climate bill (Davenport 2007b). Both newspapers ran pieces on it being an uphill battle, with the *New York Times* in an editorial noting that "only 45 Senators mostly Democrats, can be counted as yes or probably yes," with Republican Senate leadership making arguments focusing on its "unacceptable rise in energy prices" (2009, A32).

The second increase in news coverage began in the middle of Fall 2009 and lasted until around February 2010. This period is marked by political conflict over legislative proposals, climate science controversies, international meetings, and a finding issued by the EPA that greenhouse gases are dangerous pollutants. In early November the Senate Committee on Environment and Public Works approved S. 1733, a comprehensive climate change bill. It set the same goal of 17% of 2005's levels by 2050 as the House, but also included a 20% reduction target of 2020 (*CQ Almanac 2009* 2010). The bill, however, never made it out of markup and died at the end of the session.

The Senate legislation was plagued with intense opposition from industry, think tanks, Republicans and some moderate Democrats making arguments that it was too costly and too soon, given the state of computer modeling and prediction by climate scientists. News coverage was indexed to these heightened debates and to some novel, dramatic political maneuvering by Republicans. For example, capitalizing on the media attention it was receiving, Senator Voinovich (R-OH) submitted to the record a *Washington Post* front-page article that led with the observation that the "potential economic impact of climate change" was at the forefront of debate during a hearing in late October (Eilperin 2009, A1). Both the *New York Times* and *Washington Post* covered a Republican boycott of a vote to move the legislation out of committee. It was reported out despite the boycott, but as the president of the National Petrochemical and Refiners Association, Charles T. Drevna, expressed in a *Washington Post* article, "it's frustrating to see…[the committee] pass something that all realizes has no chance of passage" (Eilperin 2009, A6).

The uptick in news in late 2009 and early 2010 is also attributable to two events that brought climate science controversies to the forefront. First, at the end of the year, email messages and documents owned by climate scientists at the University of East

Anglia's Climate Research Unit in the United Kingdom were hacked and posted to the Internet. Climate skeptics picked over these files in an attempt to "show that climate scientists conspire to overstate the case for a human influence on climate change," as described in a *New York Times* article (Revkin 2009, A1). A story in the *Post* noted that "climategate," as the scandal was dubbed by the media, ranked as one of the most popular on its website (Eilperin 2009, A4). The article went on to quote Stanford University climate scientist Stephen H. Schneider, who argued that, while the scandal will not stop the debate, it will help "slow down the nation's public policy response."

The second climate science controversy took place in early 2010 when errors in the IPCC's 2007 Third Assessment went public, were picked up by the media, and seized by those in the policy community who opposed comprehensive climate legislation. For example, the *Washington Post* noted in an article that a coalition of conservative groups and lawmakers led by Senators Inhofe (R-OK) and Barrasso (R-WY) were "citing the errors as further reasons to block mandatory limits on greenhouse gas emissions" (Eilperin and Fahrenthold 2009, A1). Citing climategate and the IPCC errors as reasons, researchers Painter and Ashe (2012) found that 34% of climate change coverage in two prestige newspapers, *The New York Times* and *Wall Street Journal*, during this time period included sources skeptical of climate science, with little discernable difference between the two publications.

In addition to the climate controversies, two other events help explain the surge in media attention in late 2009 through early 2010 as well. The first, December's two-week long UN Conference on Climate Change in Copenhagen, fed into prolonged debates surrounding climate legislation in Congress at the beginning of 2010. Ending in "disarray," negotiations were deadlocked by developing countries' assertions, led by China, that the US and other developed countries put up as much as $200 billion a year to

help them mitigate and adapt to climate change (Davenport 2010a). In the end, President Obama, whose attendance was widely covered in light of his predecessor Bush's illustrious leadership role, helped negotiate the Copenhagen Accord among major polluters – China, the US, India, Brazil, and South Africa. This was a "loose" nonbinding agreement that was best described, as a *New York Times* article reported, as a "general commitment to the idea that "climate change is one of the greatest challenges of our time" and asserts that "deep cuts" in global emissions were required" (Rosenthal and MacFarquhar 2009, A10).

The second event tied to increased news coverage beginning in late 2009 was timed with the Copenhagen climate conference. On the summit's opening day, December 7, the EPA issued its finding that greenhouse gases were a dangerous pollutant and thus could be regulated by the agency according to provisions in the Clean Air Act (CQ *Almanac 2009* 2010). As a *New York Times* article noted, this strengthened the US delegation's bargaining power going in to the conference (Broder 2009, A18). The same article noted that EPA's administer, Lisa Jackson, broached the subject of the East Anglia email scandal in her prepared statement, stating that even though scientists would continue to debate the impacts of climate change, "the overwhelming amounts of scientific study show that the threat is real" (*Ibid*). The declaration by the EPA was the subject of "wide criticism" months after the rule was issued. In the background of stalling negotiations on climate legislation in the Senate, the EPA finding was condemned by a group of high-profile Democrats led by Senator Rockefeller (D-WV), who was quoted in a *New York Times* article saying that "E.P.A. actions in this area would have enormous implications, and these issues need to be handled carefully and appropriately dealt with by the Congress, not in isolation by a federal environmental agency" (Broder 2009, A19).

ATTRIBUTE DIVERSITY IN CLIMATE NEWS COVERAGE

The second variable for media signals, attribute diversity is ambiguity in the variety and concentration of the dimensions that frame climate news coverage. Increasing attribute diversity in the news is a signal that amplifies problem uncertainty in the policy community. This leads to growing competition and conflict over which attributes best characterize the climate problem definition.

Attribute Diversity and Subsystem Responsiveness

Chapter 2 on the theory of media signaling introduced the term *attribute diversity* as a key component to understanding the role of the media from an information-processing perspective. Policy problems such as climate change are inherently complex. They span multiple subsystems and policy domains. As a result, they are defined along multiple dimensions, which can shift when new information enters the policy environment (Jones 1994; Jones and Baumgartner 2005). When this happens – when attributes intrude into the problem space – subsystems often respond by shifting their attention to focus on the newly updated problem definition. In the policy processes literature, this is a precursor to problem redefinition and policy change. This dissertation argues that attribute intrusion can also keep policy debate "locked in" in the problem space, inhibiting its solution set. For example, in 2008, a year before the Senate debated cap-and-trade proposals, the economic dimensions of climate change news coverage increased by 34%. Juliet Eilperin (2009, A1) of the *Washington Post* noted the shift in describing the 2009 debates:

> For a decade or more, the political battle over climate change has been fought largely over the validity of the science of global warming. But Tuesday, as the Environment and Public Works Committee opened its first hearing on a Senate climate change bill, those concerns took a rear seat to a different issue: the potential economic impact of climate change.

Attribute intrusion can happen in one of two ways. A problem can inherit an entirely new dimension, such as when climate change was linked to increases in violent conflict in Africa (Reuveny 2007) or when the death penalty was redefined in terms of "fairness" (DeBoef, Baumgartner, and Boydstun 2008). More commonly, attribute intrusion occurs when the dimensions underlying a policy problem are reweighted so that once dormant dimensions gain greater prominence. For example, agricultural offsets grew to become a dominant dimension in the failed 2000 Kyoto climate negotiations and again in debating cap-and-trade 2009 legislation in the Senate (Revkin 2000, A21; Davenport July 6, 2009). In these examples, climate deliberations were structured by how the problem was characterized.

Regardless of its form, reshuffling of attributes increases uncertainty in the problem space (Jones 1994b, 1996, 2001). A couple of recent studies examining how subsystems respond to this phenomenon coined the attribute diversity that underlies policy problems *attribute uncertainty* and *problem uncertainty* (Shaffer et al 2015; Shafran 2015 respectively). In the Shaffer et al (2015) piece, the financial crisis of 2007-2008 opened up a window for alternative attributes to restructure how policymakers understood financial regulation. This exogenous shock – the financial crisis – was a signal that the working definition coming from the existing regulatory regime was no longer an adequate characterization of the problem. The crisis created an opportunity for several previously underweighted attributes, such as consumer protection and small business loans, to restructure ensuing policy debates on the matter.

In a similar vein, this dissertation argues that the diversity of attributes in climate change news coverage sends a signal to subsystems about how the problem – global warming and its impacts – is characterized. More than that, attribute diversity in climate news facilitates subsystem competition over defining the problem. It increases

uncertainty about how the problem is characterized, which creates windows of opportunity for subsystem participants to advance the attributes that best help them achieve their policy goals. As a result, policy activity increases as advocates from various subsystems mobilize and counter mobilize their resources to gain control over the problem definition. We can see now how attribute diversity is related to conflict expansion as described by Schattschneider (1960) and expanded by Baumgartner and Jones (1993). New attributes or changes in old ones attract the involvement of subsystems beyond the current scope of conflict.

Journalistic Practices and Attribute Diversity in News Coverage

Why do we see attribute diversity in news coverage of climate change? The answer rests upon the dynamics between the issue, the people who report on it, and subsystem players. First, the nature of the issue interacts with journalistic standards and practices to create the dimensions we see in climate news. Journalists must reduce complex scientific problems like global warming into their component parts to produce pieces that are newsworthy and relatively easy to digest (Wilson 19XX; Wyss 19XX). This is one of the reasons why we see a good deal of thematic reporting on climate change (Liu et al 2008, 2013).

Second, the causes of global warming are for the most part invisible; and climate change impacts are often long-term and far-reaching, save extreme weather events such as hurricanes.[52] Since this is the case, journalists will have an incentive to frame them in terms of existing policy domains that are historically newsworthy (Fitts 2014; Boydstun 2013), such as energy, economics, or international affairs. Once this happens, the

[52] The IPCC Third Assessment in 2001 was one of the first times scientists – and policymakers – made public linkages from climate change to extreme weather events. It was hotly contested in subsequent debates in the policy and scientific communities due to the variability and uncertainty that underlies its modeling. Most of the time most scientists qualify the relationship by emphasizing its uncertainty.

economics of the newsroom and informational efficiencies encourage routinized reporting around these dimensions (Tuchman 1978). For example, Boydstun (2013) finds that diversity in news coverage begets increases in diversity in subsequent coverage in the *New York Times* and *Wall Street Journal* in the cases of the war on terror and the death penalty.

Two additional journalistic practices and imperatives help to understand the diversity of dimensions in climate coverage: novelty and news sources. The third reason is that novelty is newsworthy (Bennett 1996, 2002; Gans 1980; Sigal 1973). As previously discussed, events such as the release of scientific reports, climate conferences, legislative hearings, and flashy technological breakthroughs, such as advances geoengineering, tend to capture the attention of journalists. Oftentimes the event will shed light upon a recent development, such as the first seriously considered cap-and-trade bill for instance. When this happens, it is more likely to receive coverage; and, coverage will emphasize the new angle. For example, the formation in 2000 of the Partnership for Climate Action, a voluntary carbon trading regime by several large energy and manufacturing corporations and the Environmental Defense Fund, was a surprising new development – an about-face in terms of the corporations' previously publically-stated policy position (Revkin 2000, C5). News coverage of their announcement highlighted dimensions associated with climate science (carbon and global warming), technology R&D (the partnership lobbied heavily for "green" R&D), and international cooperation (the partnership was formed to set the agenda ahead of Kyoto treaty climate talks).[53]

Fourth, elites are the sources of climate change attributes. We know from the conduit approach to media influence that journalists rely on elite sources as information-

[53] These were the three most prominent dimensions in the cited newspaper article on the Partnership for Climate Action, as determined by automated text and human content coding, a methodology described in more in Chapter 3.

providers for reporting on public affairs (Gandy 1982; Bennett 1990, 1996). These sources – the people operating within subsystems – are constantly competing over how to define "climate change" in the muddled problem space. Furthermore, we know from the contributor literature that policy communities often turn to the media as a venue to promote the attributes that go alongside their definition of what is the problem. Because of its scientific nature, the language of a climate change is ladened with uncertainties and probabilities. This poses a challenge to journalists in terms of translating the issue for their news consumers (Wilkins and Patterson 1991). This encourages a relationship between journalists and political elites that provides many opportunities for subsystem participants to insert their dimensions into the news. As official sources, subsystem elites provide journalists legitimacy (Bennett 1990, 1996). As information-providers, journalists will rely on subsystem participants to anchor how they write the climate story.

The Pathways to Attribute Diversity and Problem Uncertainty

How does attribute diversity come together as news organizations cover climate change? Figure 4.2 is a stylized depiction of the pathway to uncertainty caused by attribute diversity.[54] On the leftmost side of the diagram are several high-level attributes that characterize climate change: economics, weather, climate science, environment, and energy.[55] To the right are arrows that vary in their thickness, which represents the weights associated with each attribute. Notice that no two arrows are the same weight. In this rather simplified depiction (see Table 4.1 for the full list of climate news attributes), climate change is characterized along five distinct dimensions, all of which are attached to unique weights. The combination of dimensions and weights produces the attribute diversity that structures the climate change problem definition. Moving to the very last

[54] Diagram adapted from Baumgartner and Jones (2015).
[55] The 'international' dimension is excluded only for reasons of space.

box on the right of the diagram, we see that attribute diversity produces uncertainty. As in the case of Shaffer et al (2015), ambivalence underlies problem uncertainty.

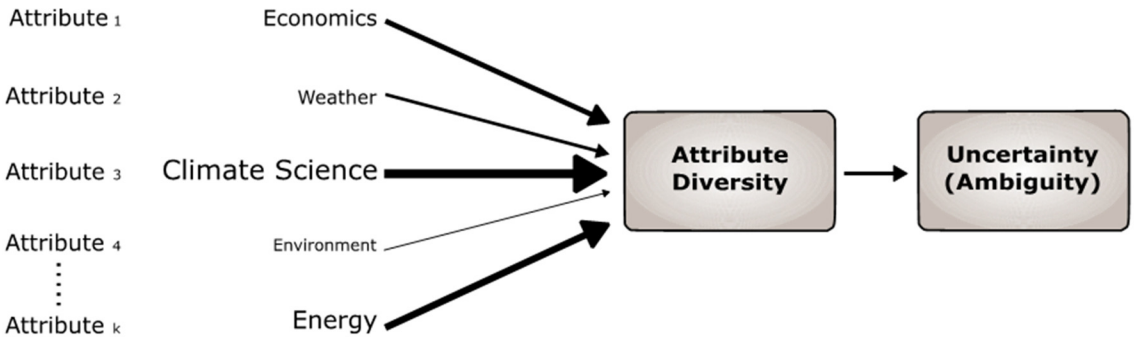

Figure 4.2: The Pathways to Attribute Diversity and Problem Uncertainty

Here ambivalence means uncertainty due to fluctuations in the concentration and number of attributes in climate news. If climate change is covered by the media in terms of only a few dimensions, with one attribute receiving far more attention than the other, then attribute diversity in news coverage is low. Attribute diversity is high when the news contains multiple dimensions that vary in their prominence in relation to each other. Thus increases in attribute diversity in climate news are signals to policy communities that its problem definition is in a state of flux. This in turn should mobilize subsystem activity.

This dynamic is on display in Figure 4.3, which shows time series of climate change attribute diversity. We can point to upticks in hearing activity in periods that follow increases in the attribute diversity in climate news. For example, in 1988 attribute diversity increased by almost 69% and the number of hearings the following year more than doubled. In 2005, almost two decades later, climate news attribute diversity increased by 28% and hearings the next year again more than doubled. A converse relationship is also on display. For instance, in 1991 and 2001, news attribute diversity

decreased by approximately 27% and 16% respectively. Hearing activity in 1992 and 2002 also decreased, by approximately 10% and 33%.

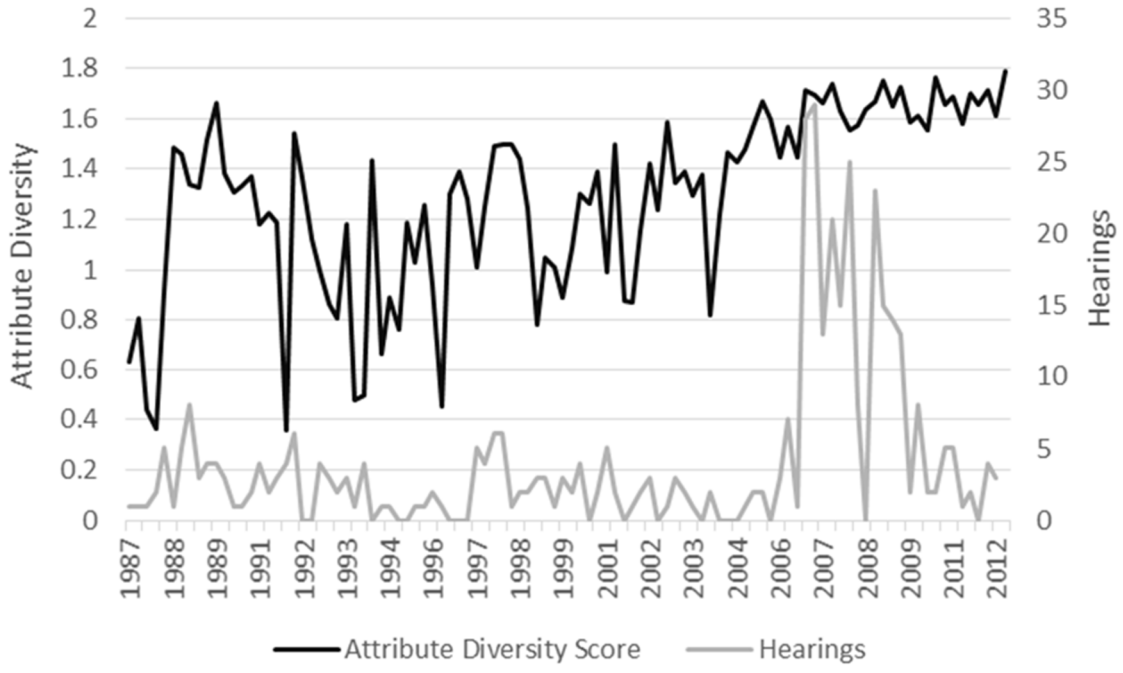

Figure 4.3: Attribute Diversity in Climate News Coverage, 1987-2012

Of course the above examples are simply illustrative.[56] They do however imply that there may be a nonlinear association between media signals of attribute diversity and subsystem responsiveness. This falls in line with what we know about the limits of attention – that individuals and institutions are disproportionate information processors. Media signals of attribute diversity may need to be above a certain threshold in order for subsystem participants to detect and process them (i.e., respond to them). This is especially likely in climate change's muddled problem space, which is characterized by

[56] The two series at the annual level are correlated at 0.49.

conflicting information about attributes, causal relationships, and the seriousness of the problem.

The messages contained in news coverage of climate change's attributes, once detected, are opportunities -- and perhaps even mandates at times – for policy communities to define the climate problem in line with what advances their goals. These goals vary: some seek to steer debate towards nonproblemicity (McCright and Dunlap 2003, 2010; Oreskes and Conway 2010; Hopmann 2011); fund more research to better understand the problem (Zehr 2000); deploy peripheral solutions such as conservation and efficiency measures in light of problem uncertainty; or, pass comprehensive legislation to reduce greenhouse gas emissions because the cost of not doing so is greater than the cost of maintaining the status quo (Zehr 2009). Management of the news by journalists and elites with stakes in climate policy allows the latter a certain amount of latitude in reshaping the boundaries of the problem definition for particular purposes (see Zehr 2000, p. 98).

Attribute Diversity in Climate Change News Coverage

This section provides an overview of the attributes of climate in two elite news publications, *The New York Times* and the *Washington Post*, from 1987 to 2012. Table 4.1 displays climate attributes and their corresponding prominence with counts and percentages aggregated across all years.[57] There are 32 unique climate attributes in news coverage, ranging from the relationship between carbon dioxide and global warming, energy conservation and efficiency, through to technology R&D (e.g., geoengineering). The 32 unique attributes are nested under umbrella categories that comport to similar studies showing that climate news conveys its complex, myriad policy dimensions (see

[57] See Chapter 3 for a discussion of how the table's content was derived and measured.

especially Liu 2008, 2013; Zehr 2009). In descending order, the prominence of these major categories is climate science (25%), energy (22%), international (18%), economics (9%), weather and the environment (7% each), national security and technology R&D (3% each), and public health (1%).

[Next Page]

Table 4.1: Attributes of Climate Change in News Coverage, 1987-2012

Attribute	Count	Percentage
Climate Science	**2169**	**25%**
Carbon dioxide and global warming	256	3%
Climate science scandals	282	3%
Computer modeling and simulation	246	3%
Sea-level rises	185	2%
Human contribution to global warming	258	3%
Natural climate variation	179	2%
Scientific reports	276	3%
Temperature trends	487	6%
Economics	**796**	**9%**
Competitiveness of US industries	110	1%
Economic benefit/threat	132	2%
Employment ("green jobs")	144	2%
Climate program costs	410	5%
Energy	**1910**	**22%**
Alternatives and renewables	693	8%
Coal	245	3%
Conservation and efficiency	527	6%
Gas and oil	328	4%
Nuclear power	117	1%
Environment	**998**	**12%**
Coastal erosion	164	2%
Endangered species	328	4%
GHG pollution	403	5%
Water conservation	103	1%
International	**1572**	**18%**
Climate summits	381	4%
Developing nations	154	2%
European Union	257	3%
International treaties	470	5%
Newly industrialized countries	310	4%
Weather & Natural Disaster	**562**	**7%**
Drought conditions	135	2%
Heat/cold waves	210	2%
Natural disasters	217	3%
Other	**603**	**7%**
National Security	246	3%
Public Health	98	1%
Technology R&D	259	3%

A handful (6) of the unique attributes stand out in terms of how much media attention they garnered over the years. The top two fall under the energy category, which is consistent with other studies (see Liu et al 2008, 2013; Zehr 2009). The two attributes -- alternative and renewable energy and energy conservation and efficiency -- garnered 9% and 7% of the media's climate agenda respectively. These energy-based solutions have been under the auspices of climate policy since Congress passed the 1990 Clean Air Act amendments (*CQ Almanac 1990* 1991). Previously, however, they were tools used in response to the energy crisis in the late 1970s. As oil prices plunged in the 1980s, these solutions were more and more likely to be attached to climate change. For example, Senator Wirth (D-CO) in 1988 from the Energy and Natural Resources Committee, was quoted in the *National Journal* as saying "[w]hat we've got to do in energy conservation is try to ride the global warming issue" (Stanfield 1988). These attributes appear in articles with titles such as: "The Problem With Biofuels; More proof that there are no easy solutions to climate change"; "Debate on Clean Energy Leads to a Regional Battle Over Jobs"; "Studies Call Biofuels a Greenhouse Threat"; "The Sun Also Braises; Renewable Energy Advocates Offer Invention That Can Harness and Ease Global Warming"; "Eat Locally, Ease Climate Change Globally"; and "Gas and the Greenhouse Effect".[58]

The third unique attribute to stand out is from the climate science dimension. "Temperature trends" garnered 6% of news coverage. The prevalence of climate science is consistent with similar studies documenting the range of climate news dimensionality (Liu et al 2008, 2013; Zehr 2009; Hulme 2009; Hopmann 2011). Furthermore, many studies focusing solely on climate science and uncertainty have documented its

[58] In order: *Washington Post* (2008, A14); Wald (2009, A13); Rosenthal (2008, A9); Weiss (1996, A15); *Washington Post* (2008, B6); and Mathews (1988, A10)

pervasiveness in structuring news coverage (Mazur and Lee 1993; Zehr 2000; Antilla 2005; Boykoff and Boykoff 2004, 2007; Painter and Ashe 2012; Schmid-Petri et al 2015). This attribute is not to be confused with news stories about weather or natural disasters. Rather "temperature trends" refers to coverage emphasizing the uncertainty in historic temperature trends as well as the variability in the temperature range of future global warming (see also Zehr 2000, p. 94). This attribute appears in articles such as: "1988 Set Warmth Record, British Meteorologists Report; Scientists Differ on Signs of Long-Term Global Trend"; "'Greenhouse Effect' Seems Benign So Far; Warming Most Evident At Night, in Winter"; "Ice Age Evidence Suggests a Mercurial Tropical Climate"; and "2007 Among Hottest Years On Record; Scientists Blame Trend On Greenhouse Gases."[59]

The fourth highest-ranking attribute is "international treaties" at 5%. Its rank is consistent with other studies (Liu et al 2008, 2013; Smith 2005; Shehata and Hopmann 2012). There a couple of reasons why this attribute garners as much coverage as it does. First, the scope of climate change – i.e. *global* warming – is by its nature a collective action problem on an international scale. Sovereign nations look to enter into pacts with others on greenhouse gas emissions reductions in order to stave off the competitive advantage of polluting countries. As shown in the preceding section, international treaties, such as the Kyoto Protocol, are highly conflictual matters. This attracts the attention of journalists, whose news organizations already carve out space for international affairs. This is even more the case for elite news publications, especially the *New York Times*.[60] The "international treaties" attribute appears in articles such as:

[59] In order: Weisskopf (1989, A20); Rensberger (1993, A19); Stevens (1995, C4); Eilperin (2007, A13).
[60] See Boydstun (2013, pp. 90 and 97) for the prominence of front-page attention to international affairs by the *New York Times*, 1996-2006.

"Crying Wolf About Kyoto"; "Amid a Hopeful Mood, U.N. Talks Set Countries on Path Toward a Global Climate Treaty"; "14 Nations to Participate in Plan to Reduce Methane; Gas to Be Used as Energy Source in an Effort to Slow Global Warming"; and "14 Nations to Participate in Plan to Reduce Methane; Gas to Be Used as Energy Source in an Effort to Slow Global Warming."[61]

The attribute "climate program costs" also garnered 5% of the news agenda across the years. This attribute is housed in the larger economics category, which consistently ranks high in many studies (Liu et al 2008; 2013; Zehr 2009; McComas and Shanahan 1999; Hulme 2009; Hopmann 2011). This attribute captures debates that center on the budget, spending proposals, and program cost estimates on a diverse set of topics such as a carbon tax, cap-and-trade, research funding, and energy bill tax credits for the low-income. By its very nature, this attribute tends to generate a great deal of elite conflict, which in turn attracts media attention. The "climate program costs" attribute appears in articles such as: "Senate Clears Spending After Fractious Debate"; "Science gets a boost in budget"; "Talk of Raising Gas Tax Is Just That; Analysts Cite Advantages but Concede Its Political Improbability"; and "Energy Boost; Solar and Wind Businesses Powered by Tax Breaks."[62]

Finally, the sixth unique attribute to receive considerable news coverage is greenhouse gas pollution, which falls under the "environment" category. Many studies have documented the prevalence of the environmental aspects of climate change, especially in its nascent years as an issue (Trumbo 1996; Mazur and Lee 1993; Mazur 1998; McComas and Shanahan 1999; Zehr 2009). It is not as dominant as one might expect given that climate change (and global warming) is fundamentally an

[61] In order: Makhiijani, (1997, A29); Rosenthal (2008, A7); Eilperin (2004, A2); Jacobs (2009, A10)
[62] In order: Herszenhorn (2009, A19); Vastag (2011, A2); Mufson (2006, A13); Huslin (2008, A14)

environmental dilemma. It is unlikely to receive media attention unless it is the source of elite conflict, linked to other issue dimensions or becomes associated with a negative policy image, like most environmental problems (Dryzek 1987; Baumgartner and Jones 1993; Ungar 1992; McComas and Shanahan 1999; Liu 2008, 2013). The "greenhouse gas pollution" attribute is found in articles such as: "Yellowstone Park Emits Tons of Carbon Dioxide, Study Finds"; "CO2 Is Not a 'Pollutant'"; "Trying to Connect the Dinner Plate to Climate Change"; and "Less Water Vapor Slows Earth's Warming Trends, Researchers Say".[63]

CAUSAL UNCERTAINTY IN CLIMATE NEWS COVERAGE

As a media signal, causal uncertainty is reporting on the tenuousness of causal relationships in climate science that link human behavior with global warming and global warming with unwanted outcomes, such as population displacement from sea-level rise. Chapter 2 on the theory of media signaling introduced *causal uncertainty* in the muddled problem space as key to understanding the role of the media from an information-processing perspective. Climate change is a highly politicized, complex scientific issue characterized by multiple uncertain, and oftentimes disputed, causal relationships. A hallmark of complex problems is that their causal mechanisms and impacts are often ill-understood (Baumgartner and Jones 2005). Scientific research on climate change plays a significant role in mediating the causal stories used by subsystems to define the climate problem. News coverage of climate science tends to be framed overwhelmingly in terms of uncertainty, either as a product of scientific language or skeptical voices from within

[63] In order: Associated Press (1997, A27); Stevens (1989, C4); Deutsch (2007, C3); Bhanoo (2010, A16)

and outside the scientific community (Wilkins 1993; Antilla 2005; Boykoff and Boykoff 2004, 2007; Boykoff 2011; Painter and Ashe 2012; Schmid-Petri et al 2015).[64]

Climate science in the news converges around three forms of uncertainty, reflecting the sources of uncertainty in scientific studies of climate change: human contribution, temperature trends (global warming), and impacts (Painter and Ashe 2012; Schmid-Petri et al 2015). These categories are based on collaborative work among media scholars and climate scientists (see Rahmstorf 2004). Figure 4.4 shows the causal pathways leading to global warming and climate change that dominate news coverage of climate science. Each arrow represents the linkage between cause and effect; and, the arrows' gray radial shading represents how each relationship is colored by uncertainty, either real or politically-motivated and manufactured.

[64] The climate science attributes news coverage data series collected and coded for this dissertation correlates at .85-.97 with the results of content coding from three well-known sentiment dictionaries that capture uncertainty: Loughran and McDonald (2011); Lexicoder (Young and Soroka 2011); WordStat Sentiment Dictionry (2012). Each of these dictionaries was altered slightly to customize it for global warming and climate change to remove/add domain-specific words. In addition to these, a domain-specific dictionary was created; and, the climate science series correlates with it at .91).

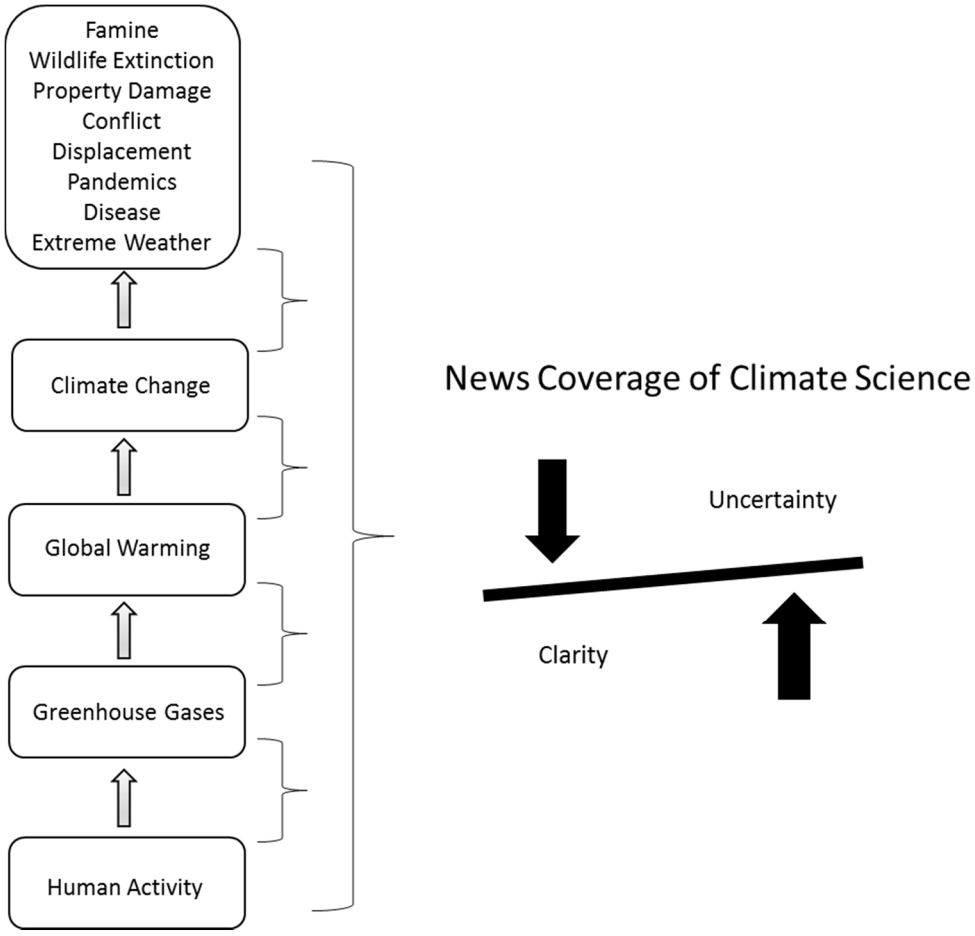

Figure 4.4: How Climate Science News Coverage Creates Causal Uncertainty

The bottom three boxes in the diagram depict uncertainty in the anthropogenic attribution to global warming and climate change, or the human contribution. The linkages between human activity resulting in greenhouse gas emissions -- especially since the industrial revolution – to global warming trends and climate change is one source of uncertainty in climate science news. This abated over time, but was particularly prevalent in the early stages of covering climate science (Wilkins 1993; Boykoff and Boykoff 2004). For example, a *Washington Post* article from 1995 emphasized uncertainty in the scientific community regarding the role of humans: "some skeptical meteorologists and

analysts assert that global warming reflects a natural cycle of temperature fluctuation and cannot be decisively tied to human actions" (Atkinson 1995, A10).

The second source of uncertainty in climate science news rests squarely on the third box from the bottom: global warming or temperature trends and atmospheric warming. In this case, scientific findings and predictions confirming an upward trend in global warming are countered by arguments that there is insufficient evidence to rule out warming that is within the bounds of natural variations. The denial or downplay of global warming imbues the linkages between it, climate change, and its impacts with large degrees of uncertainty and ushers the causal story down the path toward nonproblemicity (Dunlap and McCright 2003). An example of this in the news comes from a *Washington Post* article covering the IPCC's 2001 report "warning…that Earth's average temperature could rise by as much as 10.4 degrees over the next 100 years" (Pianin 2001, A21). The article featured a contrary view from Fred Singer, professor emeritus of environmental sciences at the University of Virginia. Professor Singer was (and still is) a frequently-used source in climate science news (Painter 2011) and has provided testimony in congressional hearings on numerous occasions. Of the IPCC's findings, Singer said:

> …charged that the U.N. study grossly exaggerated the problem. He said it was based on faulty models that don't conform to existing scientific data from thermometers at weather stations, Earth-circling satellites and high-altitude balloons. "This report is based on shaky science and is designed to present only the worst possible cases in order to scare politicians and the population and pressure the administration into signing the Kyoto Protocol."

The third type of uncertainty in climate science news centers on the causal relationships between climate change and its myriad impacts, depicted in the top two boxes. This clouds causal stories that highlight the seriousness of the problem. Climate change can be linked to extreme weather events (e.g. hurricanes), diseases (e.g. malaria), displacement, conflict, property damage (from weather events and rises in sea levels),

wildlife extinction (e.g. polar bears), and famine. Impact uncertainty is one of the more prevalent frames in climate science news in the latter decade of the data series (2001/02-2012). This coincides with the strong statements about (and evidence for) climate change impacts on human and natural systems in the third IPCC report published in 2001.

Uncertainty in climate impacts is inherent in the science, statistics, and computer modeling that underlies it, as explained by atmospheric scientist and one of the third and fourth report's lead authors, Kevin E. Trenberth, at a congressional hearing (2008-h701-65, State of Climate Science 2007, published in 2008). An example of this type of uncertainty can be found in a *New York Times* article reporting on an abrupt climate change study released by the National Research Council (Chang 2001, A19). In the article, it was noted that "[t]he scientists do not foresee any imminent changes, and the report advises that the public "not be fatalistic about the threats." The panel recommends further research to understand the mechanisms that can cause the sudden changes" and that one of the lead scientists, Dr. Alley, emphasized that "other models predict no effects." What this does is downplay the immediacy and concreteness of climate impacts, which in turn increases the uncertainty associated with arguments emphasizing the severity of the problem.

Climate science is the number one news dimension in 18 out of the 26 years that are included in this dissertation project, with an average of 32% and a range from 15%-56%. See Figure 4.5 below for a time series area graph comparing the climate science dimension with the other prominent dimensions. What is more, news coverage of climate science tends to overemphasize its uncertainty. How should we expect subsystems to respond to these strong media signals that amplify uncertainty in the causal relationships that define the problem of climate change? We should expect increased competition to define the problem among both advocates and opponents of government action to

mitigate and/or adapt to climate change in response to these signals. Causal stories are especially crucial in the problem recognition phase of the policy process (Stone 1988, 1989; Rochefort and Cobb 1994). Because of this, we should see media signals of causal uncertainty to influence subsystem activity the most at the earlier stages of the problem definition process, such as agenda setting.

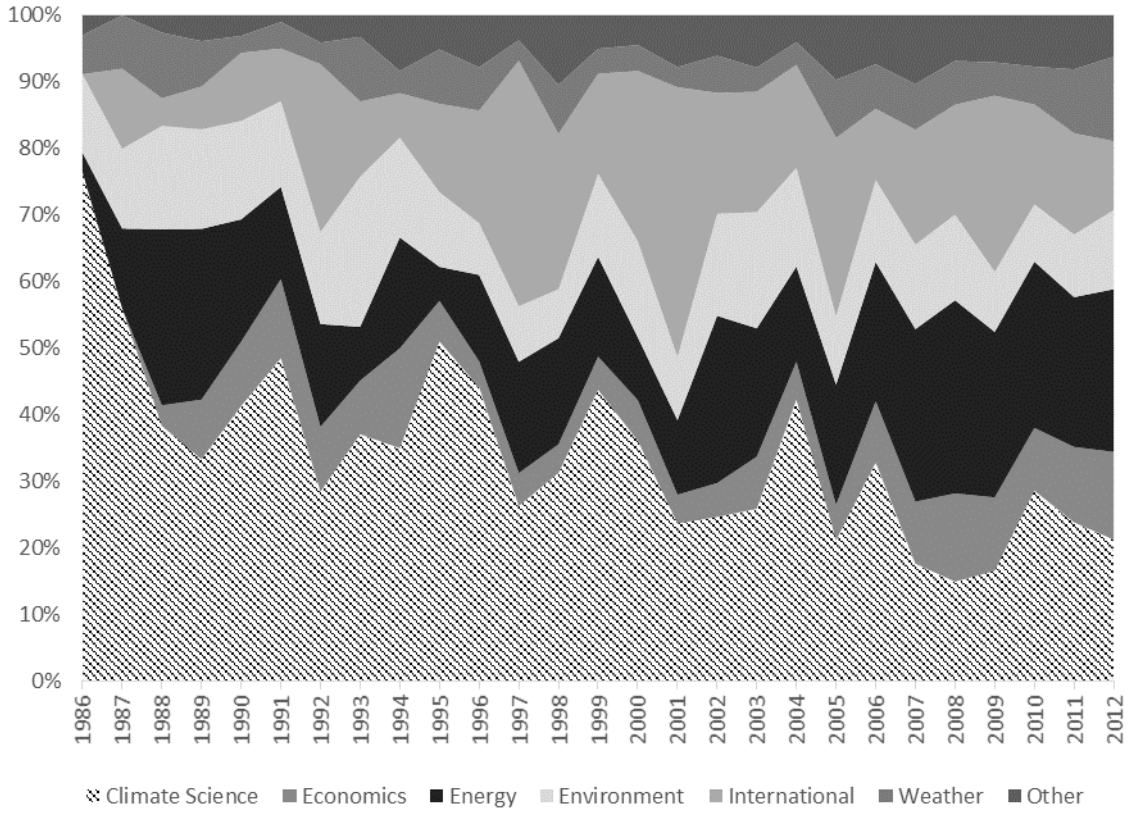

Figure 4.5: Climate Science Dominates: Area Graph of the Issue Dimensions of Climate News Coverage, 1986-2012

Both proponents and opponents of climate policy should be responsive to these media signals because competitive advantage is pursued by moderating the degrees of uncertainty associated with the various causal relationships. Proponents will respond to

media signals amplifying causal uncertainties in order to reduce them -- to make it so there is sufficient clarity in the causes and consequences to warrant large-scale and comprehensive policy solutions. Opponents will respond in order to increase them – to call into dispute the seriousness of the problem and steer debate toward smaller-scale solutions or no solutions at all. Generally speaking, media signals of climate science uncertainty are opportunities for subsystems to pursue their policy goals.

Journalistic Practices and Causal Uncertainty in the News

By and large, news coverage of climate science is shrouded in varying layers of uncertainty. Two journalistic practices produce news coverage that overemphasizes the degree of uncertainty in the causal relationships associated with climate change.[65] First, fair and balanced reporting is a standard meant to fulfill the ideal of objectivity (Cunningham 2003; Stocking 1999). Balanced reporting means presenting views of conflicting sides with roughly equal attention (Entman 1989). In covering developments in climate science and policy, journalists will include opposing viewpoints of authoritative sources – prestigious scientists, powerful lawmakers, and researchers from influential think tanks – in an effort to present a fair depiction of the range of debate. In reality, these opposing voices are oftentimes outlier viewpoints (Boykoff 2011; Oreskes and Conway 2010). This practice produces skewed representations of uncertainty, as the consensus about the causes and consequences of climate change is far greater than what is depicted in news coverage. This "balance as bias" is a common finding in studies on climate news coverage (Boykoff and Boykoff 2004, 2007; Antilla 2005; Zehr 2000; Painter and Ashe 2012).

[65] The previous two sections on what drives climate coverage and attribute diversity introduced many of the journalistic practices that also feed into the overemphasis of scientific uncertainty in climate news – events, dramatization, novelty, elite conflict, and controversies in the science community. Since these were previously covered, they are omitted from this section.

Second, news coverage overemphasizes scientific uncertainties because scientists are commonly used as sources. Scientists are used as authoritative voices when journalists cover climate science because their expertise legitimizes news content (Gandy 1979; Bennett 1996). They also help journalists sort through the complex, often arcane terminology used in scientific studies of climate change. Further, the language scientists use to describe and qualify research findings is couched in uncertainty, as is their training. This shows up in news coverage in reporting on climate science (Bailey, Giangola and Boykoff 2014). An example comes from a *Washington Post* article with the headline "Degrees of Uncertainty in Climate Studies; One Study Says Surge in Global Warming Likely; Another Highlights Unknowns" (Pianin 2001, A21):

> Another study published in Science, however, cautions that future emissions of greenhouse gases and their resulting environmental and economic consequences "are subject to large uncertainties." The study by scientists specializing in global change at the Massachusetts Institute of Technology and the University of North Carolina challenged the U.N. panel's forecast of rising temperatures over the coming century. "This finding is not accompanied by any quantification of the probability of those projections or the probability bounded by this range, and the reader is left to guess whether the likelihood of exceeding this range is 1 in 10 or 1 in 1,000," the report said.

Causal Uncertainty in the News: An Overview

As shown in the previous two sections, the science of climate change is a prominent dimension of news coverage *and* a significant driver of media attention. Figure 4.6 below shows the number of newspaper articles from the *Post* and *Times* with climate science as a prominent dimension alongside congressional hearings on climate change from 1987-2012. Comparing this figure to the area graph in the previous section (Figure 4.5), we can see that although climate science as a proportion of all news stories has

trended downward over time – though with notable variation – the number of stories with climate science as a dimension has increased.[66]

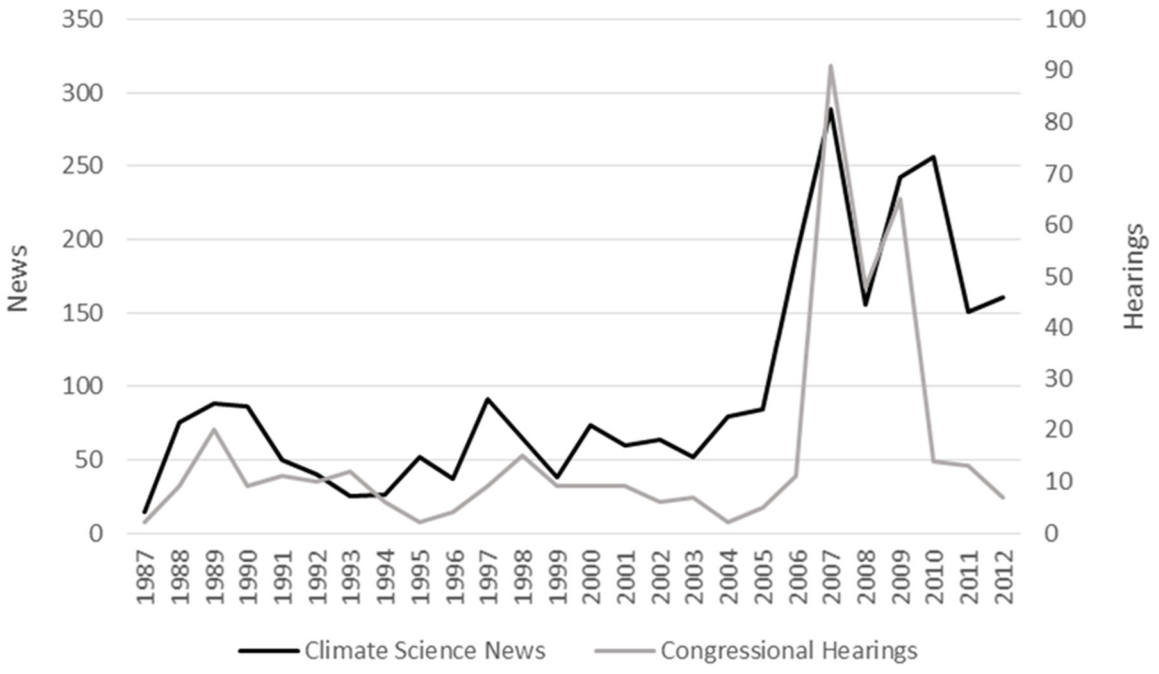

Figure 4.6: Causal Uncertainty in Climate News Coverage, 1987-2012

Eight years in the data series fall above the mean annual change score of 32%, with a range of 52% in 2004 to 436% in 1988. The years with substantial growth in climate science coverage are 1988, 1995, 1997, 2000, 2004, and 2006-2009. The large increase in 1988 holds steady for a couple of years until 1990, where it dips down by 41% by 1991. Scientists were the most-cited source on climate change until then (Boykoff and Boykoff 2004; Wilkins 1993; Trumbo 1996). Several high-profile events, elite conflict, and policy developments took place during this time period. Hearing testimony by NASA scientist James Henson, multiple wildfires, the formation of the

[66] The total volume of climate coverage increased over time as well, though not in the same proportion.

IPCC, and deliberation on carbon dioxide proposals for Clean Air Act amendments in 1988 framed news coverage of what was then mostly considered a scientific issue (Boykoff and Boykoff 2004; Wilkins 1993; Trumbo 1996).

Seventy-percent of climate science news coverage during these years centered on warming trends and the relationship between greenhouse gas emissions and global warming. These climate science attributes appear in articles with titles such as: "Area Stays Out Of 'Greenhouse' During Cool Year"; "Don't Make a Villain of the Greenhouse Effect"; "Record Hot Readings in 1980s Boost Global-Warming Theory"; "New Peril Seen on Earth Warming"; "Global Warming: Experts Ponder Bewildering Feedback Effects"; and "I'm Not Being an Alarmist About the Greenhouse Effect."[67]

The next window of heightened media attention to climate science occurred in 1995, 1997, and 2000. Coverage nearly doubled in 1995, grew by 145% in 1997, and intensified again in 2000 with a 92% increase. The news surges are tied to political turnover, releases of scientific reports, international climate talks, and elite debate regarding the uncertainty of climate change's causal relationships. In the previous period, climate science news was dominated by two attributes. In the latter period, coverage is more spread out across attributes, especially in 2000. The "human contribution" attribute appears for the first time as a substantial dimension for the first time. "Balancing dueling scientists" became a common feature of climate news in the mid-nineties (Boykoff and Boykoff 2007; McCright and Dunlap 2003). It marks the beginning of an era characterized by an overemphasis of climate science skepticism.

The IPCC Second Assessment on climate change was released in 1995. The report stated that the "balance of evidence suggestions a discernable human influence"

[67] In order: Pianin (2001, A16); New York Times (1988, A14); Specter (1990, A20); Stevens (1990, A18); Shabecoff (1989, C1); Washington Post (1989, A10).

but “future unexpected, large, and rapid climate system changes are by their nature difficult to predict” (Houghton et al 1996). Conservative think tanks and the fossil fuel industry intensified their efforts to manufacture doubt about the scientific consensus around climate change after the Republican takeover of Congress in 1994 (McCright and Dunlap 2003; Oreskes and Conway 2010). The top climate science attributes in 1995 were temperature trends, human attribution, computer modeling and simulation, and scientific findings and methodologies. These attributes appear in article titles such as: "In Rain and Temperature Data, New Signs of Global Warming”; "Global Warming Experts Call Human Role Likely”; “Global Warming Forecast Is for Slower Rate Than Previously Feared”; “Scientists Say Earth's Warming Could Set Off Wide Disruptions.”[68]

Two years later in 1997, climate science was the subject of contentious elite debate leading to the Kyoto climate summit at the end of the year. The Global Climate Information Project, a coalition of industry groups and labor unions, spent over $13 million in a media campaign against Kyoto’s emissions reductions, attacking climate science as “premature” (Boykoff and Boycoff 2007; Oreskes and Conway 2010). The Senate invited several known skeptics from the scientific community to testify at hearings to cast doubt on the scientific basis for greenhouse gas reductions. The top climate science attributes in 1997 were temperature trends, human contributions, and the relationship between greenhouse gases and global warming. These attributes appear in article titles such as: “Warming Could Bring Some Cold Surprises”; “Team Challenges Theory Linking Climate Change, Evolutionary Surge”; “Holes in the Greenhouse Effect?”; and “Complexities of Global Warming; What Scientists Don't Know -- And Why They Don't Know It.”[69]

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[68] In order: Stevens (1995, C4); Stevens (1995a, A1); Stevens (1995b, A1); Sawyer and Lee (1995, A12).
[69] In order: Stevens (1997, C2); Suplee (1997, A15); Michaels (1997, H01); Casti (1997, H01).

The increase in 2000 can be traced back to scientific studies, Kyoto climate talks again, and elite debate on climate science. A draft of the IPCC's Third Assessment report was released ahead of the international summit. It stated that humans had a substantial role in global warming and that temperature projections were higher than previously identified (Revkin 2000, A22). A group of climate scientists led by James Hansen published a study that included a suggestion that it could be more politically expedient for policymakers to focus on reducing greenhouse gases other than carbon dioxide (Revkin 2001, A1). This was seized by opponents in arguments against large-scale government intervention in mitigating global warming and the Kyoto Protocol [2003-S261-39; 2001-S261-9]. Elite debate also centered on climate modeling, calling for further research for a more "firm understanding" (McCain 2000 in 2003-S261-39 p #).

The attributes for climate science in the 2000 news coverage were temperature trends, human contributions, computer modeling and simulations, scientific findings and methodologies, greenhouse gases and global warming ,and glacial and sea ice melt. These attributes appear in article titles such as: "A Century-Long Warming Trend"; "Study Faults Humans for Large Share of Global Warming"; "Ocean Temperature Rise May Mean Warmer Times Ahead"; "Get the Easy Greenhouse Gases First "; "Surface or Air? The Great Debate Continues"; and "Antarctic Test Raises Hope On a Global-Warming Gas."[70]

Media attention to climate science increased again in 2004 and 2006. This reflects the growing tension between policy advocates and opponents, with the latter intensifying their challenges of the scientific basis for climate action (Jalonick, Kady, and Sharma, March 20, 2004). Heated political debate centering on the release of several studies, high-profile events, and policy developments during these years tracks with the growth in

coverage. The following findings from climate science reports appeared in the news: the 2003 heatwave in Europe that killed thousands was linked to global warming caused by human activity (Stott, Stone, and Allen 2004); carbon dioxide emissions were rising at a rate faster than previously found (Brahic 2006); and additional support for the much-debated "hockey stick" graph that shows a rapid rise in temperatures in recent decades (Lund, Lynch-Stieglitz, and Curry 2006). The now-infamous Stern Review, an economic analysis of climate change, was released in 2006. Its major finding was that the cost of adapting to climate change was greater than the cost of mitigating its effects (i.e., large-scale measures to reduce greenhouse gas emissions) (Eizenstat 2006, A19)

Two high-profile climate science events took place during this period. First, NASA scientist James Hansen accused the Bush Administration of trying to stop him speaking about global warming (Revkin 2006, A1). Second, former-Vice President Gore's documentary about climate science, *An Inconvenient Truth*, became one of the top-grossing documentaries of all time (Painter and Ashe 2012). Regarding policy developments during this period: Russia ratified the Kyoto Protocol (Boykoff and Boykoff 2007; the US Supreme Court announced it would hear a case on the EPA's resistance to regulating carbon dioxide (Janofsky, 2006); and legislation (S 1164) to fund climate research was met with fierce opposition by some lawmakers and industry groups (Jalonich, Kady, and Sharma March 20, 2004).

The distribution of climate science attributes in news coverage is again spread relatively evenly over many dimensions, as was the case in 2000. Though there were some notable shifts in categories: the "carbon dioxide and global warming" dimension decreased, while the sea-level rise attribute increased. In addition to the latter attribute, the following climate science dimensions garnered significant news coverage: human contribution, computer modeling and prediction, scientific reports, and temperature

trends. These attributes appear in article titles such as: “More Denial; Instead of concentrating on the changing climate, the House Energy Committee picks on climatologists; “Climate Change Will Be Significant but Not Extreme, Study Predicts”; “Climate Expert Says NASA Tried To Silence Him”; “Study Links Tropical Ocean Warming to Greenhouse Gases”; “Global Warming Is Expected To Raise Hurricane Intensity”; and “Computers Add Sophistication, but Don't Resolve Climate Debate”.

The last two significant increases in climate science coverage took place in 2007 and 2009. During these years climate science debate centered on the release of several studies, a few high-profile events, and policy developments – which were all fueled even further by the Democratic takeover of Congress in 2007. Both the House and Senate held hearings on allegations that the Bush Administration was interfering with communicating findings about global warming (Dean 2007, A17). Both chambers also debated findings from the IPCC’s draft Fourth Assessment, which included the statement that human activity accounted for most recent trends in global warming with “90% certainty” (Selin and VanDeveer 2007, p. 281). Other significant scientific reports released during this time focused sea-level rises and warming in the Antarctic (Eilperin 2009, A4), including the imminent collapse of a large ice shelf (Revkin 2009, W3).

A couple high-profile events highlighting climate science occurred during this period. Al Gore, along with the IPCC, was awarded the Nobel Peace Prize. His documentary *An Inconvenient Truth* won two Academy Awards and it, along with his perspective on global warming, was the subject of two congressional hearings. Climategate, the scandal over hacked private email messages and documents of climate scientists used by skeptics to cast doubt on the integrity of the scientific community, developed in 2009. The Senate held heated debates on cap-and-trade legislation that year

as well, with climate science as a point of contention (Mufson, Fahrenhold, and Kane 2009, A1).

The climate science news coverage in 2007 and 2009 is fairly evenly spread among five attributes. One of these dimensions, scandals, is new and reflects the allegations against the Bush Administration and climategate. Along with science-based scandals, the prominent attributes during this time period were human contribution, scientific reports and findings, temperature trends, and sea-level rises. These attributes appear in article titles such as: "Hacked E-Mail Data Prompts Calls for Changes in Climate Research"; "Climate Change Testimony Was Edited by White House"; "Agency Affirms Human Influence on Climate"; "Climate Change May Help Prevent Some Atlantic Hurricanes"; "Ever-Firmer Statements on Global Warming"; and "NOAA Scientists Say Arctic Ice Is Melting Faster Than Expected."

Summary

This chapter ties the media signals attribute diversity, causal uncertainty, and volume explicitly to a detailed history of how climate change has been covered in the news from 1987 to 2012. The relationship between each of the three media signals and subsystem responsiveness is addressed. An overview of the journalistic practices behind each media signal is provided. And further, this chapter gives a thorough accounting of how each signal appears in the content of climate news. The contributor and conduit traditions introduced in Chapter 2 are woven throughout to show how climate news is indexed to events, elite conflict over climate policy, and scientific controversies. We have laid out what attribute diversity in climate coverage looks like, where it comes from, and how it has been covered. There is now a much greater understanding of how news coverage of climate science produces an overemphasis on causal uncertainty, and how this important dimension has ebbed and flowed over time as one of the dominant news

frames. This rich discussion of attribute diversity, causal uncertainty, and volume feed directly into the next two model-based chapters that investigate how these aspects of news coverage influence problem prioritization and the generation of policy solutions in climate debates among policy communities.

Chapter 5: Prioritizing the Climate Problem

How is climate change reported on and what is the effect? This chapter focuses on the relationship between the news and prioritizing the climate problem. News coverage plays an important role in prioritizing government attention to policy problems (Baumgartner and Jones, 1993; Jones and Baumgartner 2005; Cobb and Elder 1972; Rogers and Dearing 1996). It can be a disruptive force, expanding conflict beyond relatively closed subsystem policymaking onto larger, more competitive arenas of policy debate (Schattschneider 1960; Baumgartner and Jones 1993). Prioritizing attention to climate change is a necessary precursor to coming up with its solutions.

The theory of media signaling presented in this dissertation suggests that dual dynamics are at play for how news coverage shapes the climate debate – it expands the problem, but limits its solutions. News coverage of climate change prioritizes the problem, propels it onto the agenda, and keeps it there for prolonged debates over its problem definition. It expands conflict and increases subsystem competition because it heightens attention *and* amplifies uncertainty in the problem space. What this does is that it expands our understanding of the climate problem, but it also intensifies fissures in the structure and integrity of the problem definition. Comprehensive climate solutions require broad swaths of consensus from a set of diverse coalitions. Too much uncertainty in questions of "is climate change happening", "why is it happening," and "when and what are its impacts" makes this a tremendous hurdle. This is how news coverage limits debate to smaller-scale solutions.

In examining the prioritization of the climate problem, this chapter is thus focusing on the problem expansion role of news coverage. One of the first steps in expanding understanding of the climate problem is prioritizing attention to it. Here, we

will look at two indicators of prioritization: congressional hearings and opening statements made by Members of Congress (MOC) at the beginning of these hearings. This chapter is divided into three sections. First, the first section provides a review of media signaling in the muddled problem space that characterizes the climate change debate. The second section provides a review of climate coverage and policy debates. The third section presents research design and findings on two models that look at how news coverage shapes prioritization of the climate problem.

MEDIA SIGNALING IN THE MUDDLED PROBLEM SPACE

News coverage expands the climate problem, but limits the scale of solutions used to solve it. One way it expands the problem is prioritizing government attention to it. This argument is best understood by reviewing the role the media plays in the muddled problem space that characterizes climate change. Three aspects of climate coverage – attribute diversity, causal uncertainty, and volume – influence the prioritization of attention in the muddled space. We will focus on these aspects of coverage after a short review of what is the muddled climate change problem space.

Climate change is a "truly complex and diabolical" heavily politicized, scientific policy problem (Steffen 2011; Boykoff and Yulsman 2013). Policy debates about defining the climate problem take place in what I call the "muddled problem space" of complex policy problems. The muddled space of climate change is the typical problem space on steroids. As a reminder, the muddled climate change problem space (see Table 5.1) is characterized by information oversupply (i.e., multiple and diverse sets of policy communities are involved in the climate debate and there are multiple indicators of the climate problem); multiple ill-defined issue attributes (i.e., is it a social welfare problem? If so, how? Is it best understood as a scientific issue? If so, why?); uncertain and disputed

causal relationships (i.e., does stability in temperature trends mean that global warming isn't happening? If it is, how much do humans contribute to warming? What are its impacts?); and wide-ranging contention over problem severity (i.e. human populations have always adapted to natural climate changes, so why invest resources in mitigating carbon emissions? We don't know how much humans contribute, so let's invest in less costly solutions such as renewables). These four characteristics imbue the climate problem with a very large amount of uncertainty. They are at once the result and the fomenter of heightened, boundary-spanning competition and protracted conflict among subsystems to define the climate problem.

Table 5.1: Characteristics of the Muddled Problem Space

Characteristic	**Muddled Climate Change Problem Space**
Information	Oversupply
Issue Attributes	Multiple, ill-defined
Causal Relationships	Multiple, uncertain and disputed
Severity	Contention, wide-range
Competition	Open, boundary-spanning
Conflict	Protracted
Goal of Actors	Steer debate, negative *and* positive agenda-setting

How does climate news coverage fit into policy debates in the muddled problem space? How does it prioritize attention to the climate problem? The theory of media signaling suggests a large role for the media to shape debate and prioritize attention *because* the problem space is uncertain and messy. There are two opposing goals of actors operating in the muddled problem space in the climate debate. You have advocates who wish to reduce uncertainty in order to best define and solve the problem. And you have opponents, who capitalize on climate uncertainties in order to intensify them and limit debate, and hence climate solutions (Liftin 2000; Sewell 2005; McCright and

Dunlap 2003; Oreseks and Conway 2010). Both sets of actors respond to media signals on the uncertainty and the salience of the climate problem.

What is the content of these media signals that produce uncertainty and salience? And what are the effects on prioritization? From the information-processing perspective, policy communities inside and outside of governing institutions will look to news coverage as a source of information that will aid them in detecting, understanding, and categorizing the climate problem (see Workman et al 2009; Jones and Wolfe 2010; Wolfe et al 2013). As a reminder, the three media signals expected to have a large influence on shaping the climate debate are attribute diversity, causal uncertainty, and volume (see Table 5.2).

Table 5.2: Three Media Signals of Climate Change

Media Signal	Description
Attribute Diversity	Ambiguity in the variety and concentration of the dimensions found in climate change news coverage. This leads to amplifying problem uncertainty.
Causal Uncertainty	Reporting on the uncertainty in the causal relationships that link human behavior with global warming, global warming with climate change, and climate change with its impacts. This leads to intensifying disputes over causal stories and problem severity.
Volume	The amount of attention the media devotes to climate change. This increases the salience and importance of the climate problem.

First, attribute diversity is ambiguity in the variety and concentration of the dimensions that define the climate problem that appear in news coverage. As a media signal, this leads to amplifying problem uncertainty. It is a signal to subsystems that the attributes used to define the climate change problem definition are becoming unstable. Subsystems pursue their goals by trying to monopolize problem definitions. Signals of problem uncertainty will (re)focus and heighten their attention to compete over the

climate problem. Second, causa uncertainty in news coverage is reporting of the uncertainty in the causal relationships that link human activity with global warming, global warming with climate change, and climate change with its impacts. As a media signal, it intensifies disputes over problem severity. It sends a signal that the seriousness of the problem is in question. In terms of prioritizing the government agenda, this signal is expected to have a dampening effect. Clarity in causal relationships has been shown to be a precursor for government problem prioritization (Stone 1988, 1989; Rochefort and Cobb 1994; Scheberle 2005; Brunner 1991). Once on the agenda, however, it should prioritize competition and increase conflict in policy debates. Finally, the volume of coverage is the amount of attention the media devotes to climate change. As a media signal, it increases the salience and importance of the climate problem. This is a signal of increased urgency to better understand and perhaps to even capitalize on the climate problem.

CLIMATE NEWS: COVERING ELITE DEBATE AND SCIENTIFIC UNCERTAINTIES

One reason to expect a large role for media influence on problem prioritization is because climate news is indexed to elite debate and scientific uncertainties (McComas and Shanahan 1999; Zehr 2000; Mazur and Lee 1993; Trumbo 1996). Journalistic standards and the economics of the newsroom make it so that climate news coverage highlights conflict and competition among elites in the problem definition process. This also includes controversies over causal uncertainty in climate science (Boykoff and Boykoff 2004, 2007). Subsystems respond to climate coverage precisely for these reasons – it provides crucial information about their competitive (dis)advantages in defining the climate problem. It also provides windows of opportunity for policy communities to shape the climate debate.

This take on media influence comes out of the information-processing approach to studying the policy process – the contributor framework introduced in Chapter 2. As a reminder, this perspective puts a premium on understanding how media signals feed back into the system, altering long-term policy dynamics (Jones and Wolfe 2010; Jones and Baumgartner 2005). There is a good deal of support for the positive feedback role of the media to prioritize problems and set the policy agenda (Baumgartner and Jones 1993; Cobb and Elder 1972; Rochefort and Cobb 1994; Soroka 2002; Jones and Baumgartner 2005; for a review see Van Aelst and Walgrave 2006). This dissertation takes the contributor perspective, expands notions of media influence beyond salience, and incorporates the conduit approach from the communications literature to explain how journalistic norms and practices fit into media signaling in the muddled problem space.

The conduit approach tells us that climate coverage should be indexed to the parameters of elite conflict, as we should expect with news on public affairs (Bennett 1990, 1996). Indeed, we see this in climate news. Domestic politics and scientific controversies drive climate coverage (Trumbo 1996; McComas and Shanahan 1999; Mazur and Lee 1993; Zehr 2000; Boykoff and Boykoff 2004, 2007). Journalists rely on official sources for policy and scientific expertise (Gandy 1982; Bennett 1990, 2002; Molotch and Lester 1974). We see this reflected in climate news coverage as well, where sources are often high-profile elected officials, scientists, think tanks, and advocacy groups (Shesheta and Hopmann 2012; Painter and Ashe 2012; Boykoff 2011; Liu et al 2008). This kind of coverage – news that is indexed to elite conflict and scientific controversy and relies heavily on official sources – sends signals to policy communities about the status of the climate debate. It is a message that contains information about who is defining the problem and how it is being defined, i.e., the competitive element of subsystem policymaking.

We also know from the conduit approach that the journalistic ideal of objectivity is pursued through the practice of fair and balanced reporting (Entman 1989; Bennett 1996, 2002). What this does in terms of climate coverage is create a "balance of bias," where the news overemphasizes climate science uncertainties (Boykoff and Boykoff 2004, 2007; Zehr 2000; Antilla 2005; Painter and Ashe 2012; Schmid-Petri et al 2015). Because scientific controversies and elite disputes over climate science are major drivers of news coverage, causal uncertainty is often a predominant dimension. We took a look at causal uncertainty in climate science coverage in detail in the third section of Chapter 4. Climate science as a proportion of the news agenda was as high as 56% in 1987, 35% in 2000, and 42% in 2004.[71] This is a pretty stark signal that goes back in to the muddled problem space, intensifying disputes over the severity of the climate problem. In line with what many who study scientific uncertainty from the conduit approach assume, the theory of media signaling expects that this makes it more difficult for government to prioritize the climate problem. However, media signaling – housed in the contributor framework – also suggests that science coverage will prioritize attention to defining the climate problem once it is on the agenda.

Finally, the conduit literature illuminates the importance of novelty, exciting developments and dramatic events, and routinized reporting of complex policy problems as journalistic imperatives that shape news on public affairs (Gans 1980; Tuchman 1978; Bennett 1996, 2002). This has a very significant implication for media signals of attribute diversity in the muddled problem space. Recall that subsystem competition over the climate problem involves delineating which attribute or set of attributes best defines the problem, and thus structures its solutions. For example, Rep. Barton emphasizes the

[71] These figures are consistent with other studies that quantify the amount of climate science coverage over extended periods of time (see especially Liu et al 2013; Boykoff and Boykoff 2004).

perils of economics and climate science in his opening statement at a congressional hearing in 2007, advocating for cautious solutions for reducing greenhouse gas emissions. Former Vice President countered with a third dimension – social welfare – in his testimony at the same hearing, arguing for a large-scale shift in how we approach climate solutions.[72]

The novelty and drama associated with Gore's testimony – he was the sole witness at two congressional hearings that day – makes it more likely that social welfare dimension will be covered in the news. Journalistic imperatives make it so that burgeoning dimensions of climate change will receive coverage, especially if tied to elite sources and conflict. The event-driven nature of the news, coupled with journalistic zest for novelty, implies that the number of attributes used to frame climate news will be at times high, diverse, and in motion. Indeed, a synthesis of mostly conduit literature on climate change in the news reveals it is covered using multiple dimensions, including climate science, economics, energy, environment, international affairs, weather, national security, public health, and climate technologies (e.g., geoengineering) (Liu et al 2008, 2013; Zehr 2000, 2009; Smith 2005; Shehata and Hopmann 2012). Attribute attribute diversity is a signal about increasing problem uncertainty, as it casts doubt over the integrity of which attributes structure the climate problem. When this happens, attention to the climate problem is prioritized.

RESEARCH DESIGN AND FINDINGS

How does news coverage prioritize attention to the climate problem? The theory of media signaling suggests that three aspects of climate coverage – attribute diversity, climate science, and volume – are signals to policy communities operating in the

[72] Vice President Al Gore's Perspective on Global Warming, House, 110th Cong., 2007.

muddled space about problem uncertainty, problem severity, and the salience of the climate problem. Once detected, these signals intensify competition and conflict over the climate change problem definition. Prioritization is one of the first steps in the problem definition process that leads to problem expansion – that is, more attention and resources devoted to debating and understanding the problem in order to delineate its solutions. The remainder of this chapter is devoted to exploring the empirical relationship between news coverage and two indicators of problem prioritization – congressional hearings and opening statements made by Members of Congress (MOC) at the beginning of these hearings. This section is organized as follows: a review of data collection and content coding of news coverage, followed by a presentation and discussion of the findings.

Data: Hearings and Opening Statements

The two dependent variables in this chapter used to examine problem prioritization are the count of congressional hearings per calendar quarter and the number of opening statements made by MOCs per hearing from 1987-2012. As a reminder, hearings are an indicator of government problem prioritization and considered an arena for subsystem competition (Baumgartner and Jones 1993; King 1997; Worsham 1997; Baumgartner, Jones, and MacLeod 2000; Jones and Baumgartner 2005). Opening statements made by MOCs are acts of high-profile policy brokers prioritizing attention to problem definition *after* climate change is on the policy agenda. Policy brokers are integral players in theories of policy change that focus on the problem definition process (Kingdon 1995; Sabatier and Jenkins-Smith 1993; Baumgartner and Jones 1993; Mintrom and Norman 2009).

To explore government problem prioritization, 406 hearings were collected from *ProQuest,*[73] Policy Agendas Project,[74] and the US Government Publishing Office (GPO).[75] Hearings on climate change were revealed by conducting a key word search using a standard set of terms ("greenhouse gases", "greenhouse effect", "global warming", "climate change").[76] After reading *ProQuest* descriptions and the first few pages to eliminate non-relevant hearings, results were cross-referenced with the Policy Agendas Project's data series on congressional hearings in categories 705 (global warming and air pollution) and 1902 (international resource agreements).[77] The full text of opening statements made by MOCs was collected from these hearings, totaling 1,818 statements between 1987 and 2012.

Figure 5.1 below shows the number of congressional hearings on global warming/climate change per calendar quarter (top) and the number of opening statements made by MOCs per hearing (bottom) from 1987-2012.

[73] http://congressional.proquest.com/profiles/gis/search/basic/basicsearch
[74] www.policyagendas.org
[75] https://www.gpo.gov/fdsys/browse/collection.action?collectionCode=CHRG

[76] This set of terms is standard in media and policy studies of climate change. See for example Liu et al 2011, Boykoff and Boykoff 2004, 2007; Park et al 2010; Fisher et al 2013.
[77] www.policyagendas.org The Policy Agendas Project maintains a data series on congressional hearings that is coded for policy content using a consistent and reliable coding scheme that is backwards compatible, i.e. it allows for comparisons over time. The full coding system can be accessed here http://www.policyagendas.org/page/topic-codebook. Data and the coding scheme have been used in numerous peer-review studies and in books printed by major publishers (for a select few, see Baumgartner and Jones 2015; Jones and Baumgartner 2005; Jones and Baumgartner (eds) 2009; Baumgartner et al 2011; Wolfe 2012).

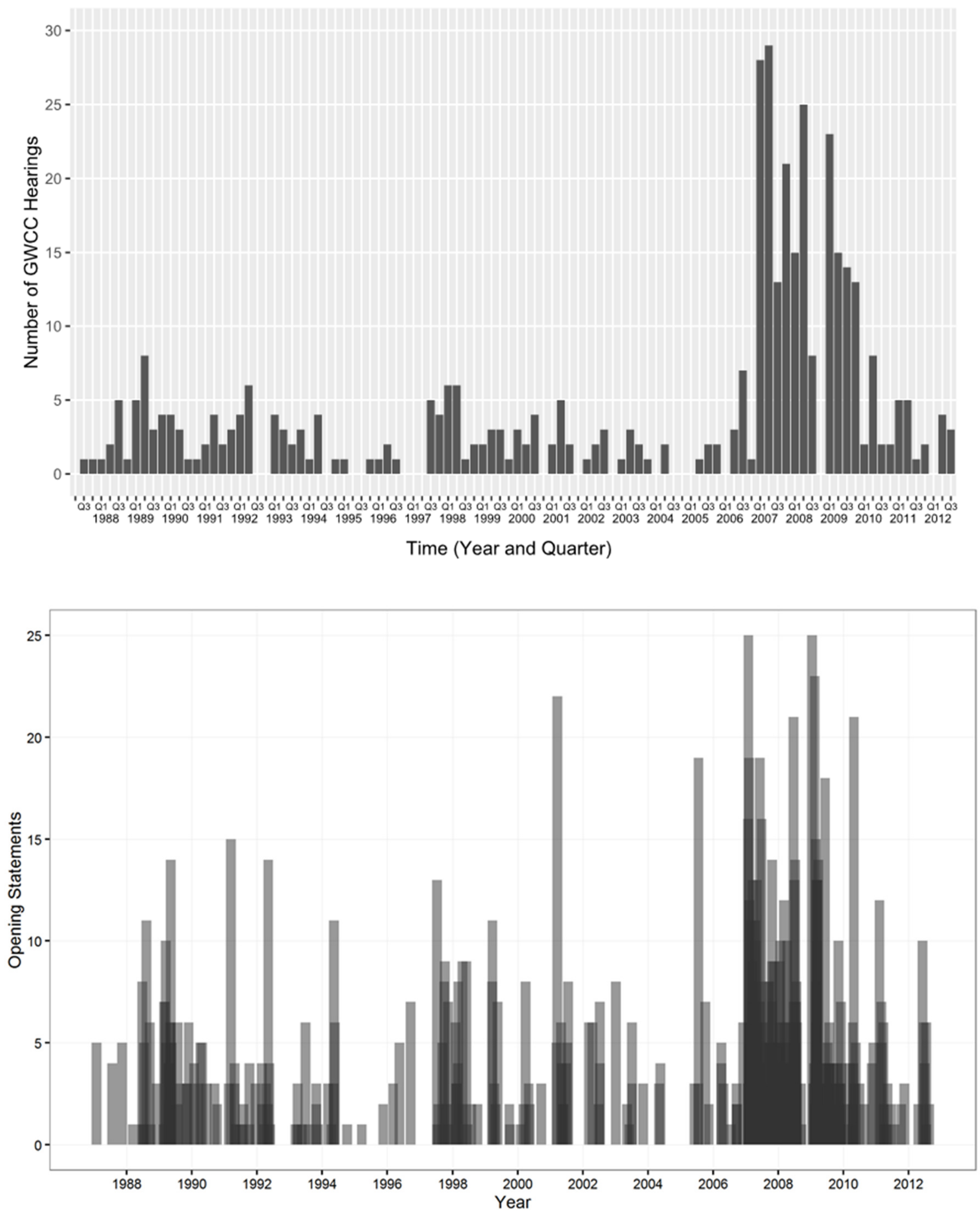

Figure 5.1: The Number of Climate Change Hearings per Quarter and Opening Statement per Hearing, 1987-2012

The average number of hearings is 3.9, with a standard deviation of 5.8 and a range of 0-29 per calendar quarter. Note the gradual rise and decline in congressional hearings until the last eight to 10 years of the series. We see spikes in hearings in 1989, 1992, 1998, and then in 2007, and 2009. In 1989, Congress was debating a "wide range of solutions to the global warming threat" as part of draft provisions for the Clean Air Act amendments of 1990 (*CQ Almanac 1990* 1991). Debate over the cost of solutions, such as gas taxes to cut emissions, in light of scientific uncertainties stalled carbon reduction legislation. Instead, the House and Senate passed the US Global Climate Research Program. In 1992, congressional hearings focused on research program oversight and global strategies to reduce greenhouse gas emissions ahead of the Rio Summit, which was a point of contention between the Democratically-held Congress and Republican President Bush (*CQ Almanac 1992* 1993).

In 1998, nearly every hearing examined the Kyoto Protocol negotiated in late 1997 that would have had the US reduce its carbon emissions without binding industrializing countries (China, India, and Brazil) to the same agreement. Signed by President Clinton, Sen. Murkowski (R-AK), then-chairman of the Senate Energy and Natural Resources Committee, said "[t]he Kyoto deal is dead on arrival" (*CQ Almanac 1997* 1998). And it was. In the first quarter of 2007, congressional hearings more than doubled from all held the previous year. The Democrats took over majority status in both the House and Senate.[78] They held hearings on allegations of interference with scientists at federal agencies by the Bush Administration (*CQ Weekly* Feb. 5, 2007); climate science in light of the draft IPCC Fourth Assessment; energy efficiency, renewables, and

[78] The House established the Select Committee on Energy Independence and Global Warming at the beginning of the 110th Congress. Even so, this is not the source of the increase in congressional hearings. The Senate, which did not have such a committee, held 43% of hearings on climate change in 2007, which is just below their global average of 45%. Rabe (2007) cites a large increase in jurisdictional competition over climate change in the Senate in particular starting in the 110th Congress.

fuel standards (Davenport 2007); and proposals on several comprehensive solutions to climate change, including carbon tax and cap-and-trade (Palmer 2007).

Looking back to Figure X.X, the bottom graph displays the number of MOC opening statements per hearing from 1987-2012. The bars on the X-axis are shaded to present these numbers in time periods with clusters of hearings. As you can see, there is quite a lot of variation in the number of statements made by MOCs over the years, with new highs reached in 2001 and 2007, with 22 and 25 statements respectively.[79] The average number of statements is 4.4, with a standard deviation of 4.2 and a range of 0-25 per hearing. The average number of statements made by Democrats and Republicans is virtually the same, 2.2 and 2.3 respectively. The following excerpts are examples of what is being said about the climate problem in opening statements:

> Ronald Reagan said that facts were stubborn things. … . The topic of today's hearing is a consorted effort by opponents of measures to reduce greenhouse gas emissions, to bully scientific facts into submission, and, under intense pressure, the facts about global swarming caved in and proved much more elastic, much less stubborn than Ronald Regan had us believe.[80]

> …[t]he problem with global warming is that we don't yet know whether it represents a genuine national threat, and if so, how large.[81]

Table 5.3 provides examples of hearing topics for a range of statements made per hearing, with the title of the hearing displayed. The topics in this

table cover climate science, clean energy, political scandal and scientific controversies, developing countries, treaties, economics, and agriculture. The number of statements range from 4 in 1989 (agriculture) to 22 in 2001 (climate science).

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[79] The most opening statements in the original data series is 41 over a three-day period in 2007. This Senate hearing (American's Climate Security Act of 2007, S2191) was removed as an outlier. It was held to debate S 2191, a cap-and-trade bill.

[80] Chairman Brad Miller (D-NC) in Shaping the Message, Distorting the Science: Media Strategies to Influence Science Policy, 2007.

[81] Sen. Bond (R-MO) at 98-S321-8

Table 5.3: Hearings for a Range in the Number of Opening Statements

Hearing Title	Statements	Year
Clean Air Act Oversight Issues: Science of Global Climate Change and Greenhouse Gas Emissions	22	2001
Clean Energy Policies to Reduce Oil Dependencies and Greenhouse Gas Emissions	21	2010
Allegations of Political Interference With the Work of Government Climate Change Scientists	16	2007
Joint Hearing on the Potential Impact of Global Warming on the Third World	14	1989
EPA's Proposed Renewable Oxygenate Standard	11	1994
Countdown to Kyoto, Parts I-III	10	1997
Climate Science: Empowering Our Response to Climate Change	10	2009
Climate Treaty: The Impacts of a New Climate Treaty on US Labor, Electric Supply, Manufacturing and the General Economy	8	1997
National Imperatives for Earch and Climate Science Research and Applications Investments Over the Next Decade	6	2007
Climate Change and Agriculture	4	1989

Data: Collecting and Content Coding News Coverage

The independent variables for news coverage are attribute diversity, causal uncertainty, and volume. For news coverage, 4,765 full-text newspaper articles were collected from *The New York Times* and *The Washington Post* from a *LexisNexis*[82] keyword search limited to the headline and the leading paragraphs. The keywords used were the same as those used to collect hearing data: "greenhouse gases", "greenhouse effect", "global warming", "climate change." Irrelevant articles – those only mentioning climate change in passing – and duplicates were removed to make up the final data series. The *Times* and the *Post* are two of the most commonly-used elite news organization in studies of policy attention (see Jones and Baumgartner 2005; Baumgartner and Jones 1993; Boydstun 2013; Liu et al 2011; Baumgartner et al 2008) and of climate change (see Boykoff and Boykoff 2004, 2007; McComas and Shanahan 1999; Liu et al 2011, 2013).

[82] http://www.lexisnexis.com/hottopics/lnacademic/

Volume of Coverage

We now turn to volume of coverage. Volume is the amount of media attention devoted to climate change. As a media signal to policy communities, volume moderates the importance and salience of the climate problem. Volume as media attention has long been linked to policy agenda dynamics (Baumgartner and Jones 1993; Jones and Baumgartner 2005; McCombs 2008; Boydstun 2013; see Van Aelst and Walgrave 2006 for a review). There are 4,765 newspaper articles in the data series that spans 1987-2012. Volume is measured as the number of newspaper articles per unit time. At the monthly rate, the volume of climate change coverage averaged 15.4, with a standard deviation of 17.8 and a range of 0-114.

Figure 5.2 below displays the volume of news coverage from 1987-2012, aggregated at the quarterly level. The first section of Chapter 4 discusses volume of coverage for climate news rather extensively. As a reminder, there are peaks and valleys in volume, with some notable increases in 1988, 1992, 1997, 2000-2001, followed by a steady increase starting in late 2004, with a surge in 2007 and again in late 2009-2010. This movement in volume is consistent with other studies of climate change in the news (Ungar 1992, 1995; McComas and Shanahan 1999; Boykoff and Boykoff 2004, 2007; Liu et al 2011, 2013).

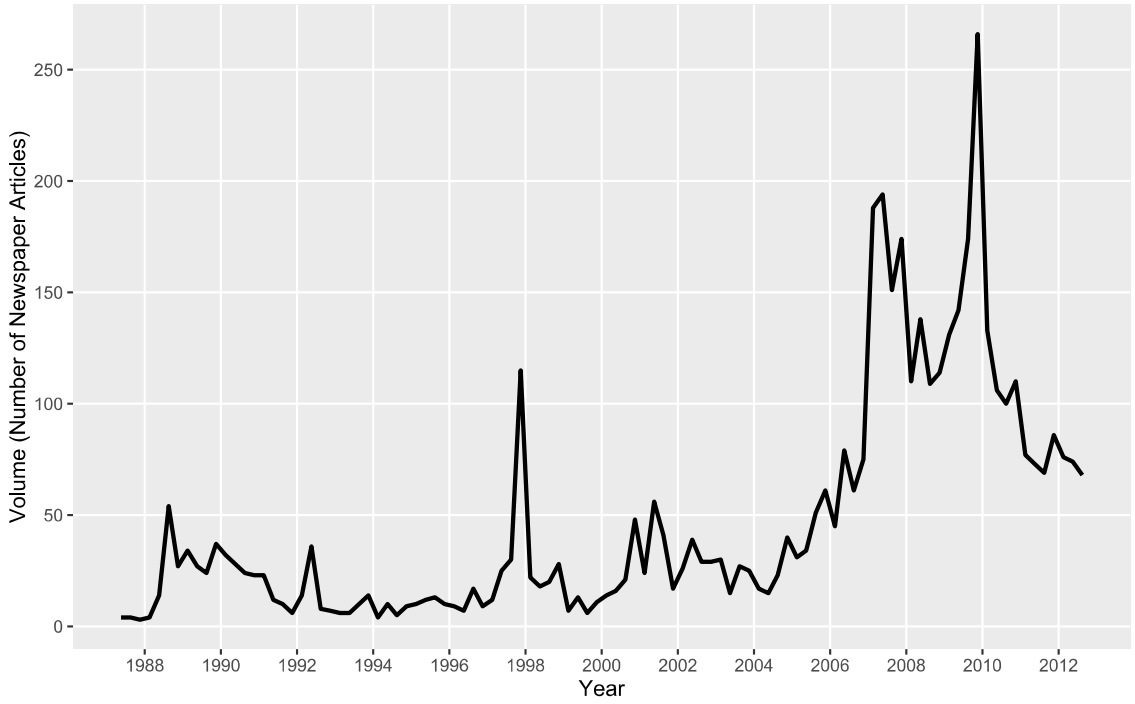

Figure 5.2: Volume of News Coverage on Climate Change, 1987-2012

Content Coding Climate News for Attribute Diversity and Causal Uncertainty

Newspaper articles were coded for climate change policy and science content, the results of which were used to construct attribute diversity and causal uncertainty. Content coding was conducted using a two-step machine-human hybrid approach to analyzing political texts. First, an automated topic model, known as *latent Dirichlet allocation* (LDA) was used on the newspaper articles to uncover the attributes of climate news. Then after robustness checks,[83] the clusters of words from the topic model – known as

[83] Robustness is defined as the stability and validity of topic terms for small changes in the number of topics estimated (Blei 2012; Grimmer and Stewart 2012; Grimmer and King 2010). I settled on a model that estimated 75 sets of topic terms for climate coverage attributes. After removing "junk" categories, and

"topic terms" – were each assigned a substantive climate attribute topic using an extensive codebook that was developed for this project (see Table A.1 in Appendix A). This codebook is based on a meta-analysis of the literature on climate change news coverage,[84] cross-referenced with a sample of Government Accountability Reports on climate change,[85] and converted into a modified version of the Policy Agendas Project codebook[86] specifically for climate change attributes.

As a reminder from the detailed discussion of attribute diversity in news coverage in Chapter 4 (section two), there are 32 unique issue attributes found in climate news from 1987 through 2012. Table 5.4 provides descriptions of attributes nestled under nine distinct umbrella dimensions: climate science, economics, energy, environment, international, extreme weather, and other (national security, social welfare, and technology R&D).[87] The attributes of climate coverage range from the relationship between carbon dioxide and global warming, temperature trends, competitiveness of US industries, "green jobs", alternative and renewable energy, coal, nuclear power, coastal erosion, greenhouse gas pollution, water conservation, climate summits and treaties, drought conditions, hurricanes, deaths from heat/cold waves, disease epidemics, and geoengineering.

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topics that identified locales, political actors, and entertainment without policy content, 49 topic terms remained.

[84] See for example Ungar (1992, 1995); McComas and Shanahan (1999); Boykoff and Boykoff (2004, 2007); Liu et al (2008, 2013); Antilla (2005); Trumbo (1996); Zehr (2000; 2009); Mazur and Lee (1993). Section two of Chapter 4 includes an extensive discussion of attribute diversity in climate news coverage.

[85] Several of the reports were prepared as witness testimony in hearings. The following reports were used: RCED-90-58, GAO/RCED-99-235R, GAO/RCED-00-166R, GAO-07-863, GAO-08-605, GAO-09-534T, GAO-11-317, GAO-11-876T, GAO-12-283, and GAO-13-242. These reports also informed the development of solution typologies used in Chapter 6.

[86] http://www.policyagendas.org/page/datasets-codebooks#codebook

[87] National security, public health, and technology R&D are considered umbrella categories but are presented as "Other" for display purposes.

Table 5.4: Attributes in News Coverage by Major Climate Category

Category	Description of Attributes
Climate Science	Carbon dioxide and global warming, climate science scandals, computer modeling and simulation, sea-level rises, human contribution, natural variation, scientific reports, temperature trends
Economics	Competitiveness of US industries, costs/benefits, employment (e.g., "green jobs"), climate program costs
Energy	Alternatives and renewables, coal, conservation and efficiency, gas and oil, nuclear power
Environment	Coastal erosion, endangered species, greenhouse gas emissions and pollution, water conservation
International	Climate summits, European Union, international treaties, newly industrialized countries (China, India, and Brazil)
Extreme Weather	Drought conditions, heat/cold waves, hurricanes
Other	National security, public health, technology R&D

An automated topic model approach was used to uncover the topics that structured the collection of newspaper articles. The topics that were generated were then assigned substantive codes for policy content by hand. How do topic models content code text? Topic models group words that are semantically – that is, thematically – related. This produces the "topic terms" to which humans assign meaningful codes. One of the advantages of the topic model approach is that groups of words can share words. For example, "climate change" can be grouped with "greenhouse gas" in one topic and "sea level" in another. This is becoming a popular approach to analyzing political texts, such as how newspapers cover terrorist threats (Bonilla and Grimmer 2013), attribute uncertainty in congressional hearings during the 2008 financial crisis (Shaffer et al 2015), issue definitions of spent nuclear fuel in witness testimonies (Nowlin 2015), how climate policy and science is discussed in conservative think tank reports (Boussalis and Coan 2015), and how the Senate agenda is set through press releases (Grimmer 2010) and floor speeches (Quinn et al 2010).

The specific topic model used is known as *latent Dirichlet allocation* (LDA) (Blei, Ng, and Jordan 2003; Blei 2012). This approach assumes that K topics structure a corpus of documents,[88] but not all K topics are in an individual document D_i. For example, the meta-analysis of media studies and Government Accountability Office (GAO) reports on climate change policy shows that there are roughly 32 unique attributes in climate news coverage (Wolfe Forthcoming). We expect to find all of these attributes within the entire collection of nearly 5,000 newspaper articles, but we do not expect a single newspaper article to contain all 32 attributes. The LDA topic model estimates K topics for the corpus and assigns a proportion "score" to each K_i topics for each document D_i in the corpus. Put another way, this approach assigns each document – here a newspaper article – a proportion "score" for each of the topics that define the entire collection of 4,675 news stories.

After machine-generating the topics with LDA, I assigned each topic a substantive policy content code that aligns with known climate attributes from the codebook developed for this project. (See Table A.2 in Appendix A). Table 5.5 provides examples of the relationship between the topic terms, attribute name, and major climate dimensions. The right column displays the first five words for a sample of topic terms generated by LDA.[89] The middle column is the topic – attribute – name assigned to it, and the left column is the major climate dimension. The topic names for this dissertation

[88] The number of topics and the topic structure depends on the research question of the investigator (Blei 2012).

[89] To check for topic code validity and reliability of manual coding, I followed standard practices in the communications field (Nueundorf 2002) and the burgeoning applied topic models literature (Grimmer and Stewart 2012; Hopkins and King 2010; Quinn et al 2010; Bonilla and Grimmer 2013). I read the top 15 newspaper articles from each set of topic terms as determined by the proportion assigned by the LDA estimates, which amounts to a 20% sample of the entire newspaper corpus. First, I confirmed that there was a vein of similarity flowing through the sample articles reflecting the set of topic terms. In all cases, the average similarity score was approximately 90%, with a range of 70-100%. A topic (attribute) name was then assigned to the topic terms. A 10% random sample of the entire corpus was re-coded for attribute code, which resulted in a global intra-coder reliability score of approximately 85%.

are consistent with Boussalis and Coan's (2015) study of think tank reports using LDA. They are also align with the literature that content codes climate news coverage (Boykoff and Boykoff 2004, 2007; Liu et at 2008, 2013; Zehr 2000, 2009; McComas and Shanahan 1999; Trumbo 1996).

Table 5.5: Topic Terms Assigned to Topic Attributes for the Dimensions of Climate Change

Dimension	Topic (Attribute) Name	Topic Terms
Climate Science	Temperature trends	warm temperatur model degre global
	Sea-level rise	ice arctic sea melt glacier
	Science scandals	climat scienc scientist research scientif
	Carbon dioxide/global warming	atmospher carbon effect dioxid earth
	Human contribution	year human ago planet age
Economics	Employment ("green jobs")	work technolog like one new
	Climate program costs	program million plan fund project
Energy	Oil and gas	oil gas energi drill natur
	Alternative fuels	ethanol crop use product corn
	Renewable energy	energi electr power percent wind
Environment	Endangered species	speci bear said fish anim
	Coastal erosion	sea rise level water island
	Greenhouse gas pollution	carbon dioxid emiss greenhous gas
International	International treaties	kyoto treati countri emiss unit
	Industrializing nations	countri china unit world india
	Developing countries	countri world develop africa nation
Extreme Weather	Natural disasters	chang climat weather hurrican drought
	Cold waves	like winter one snow peopl
Other	National Security	secur war militari unit nation
	Public Health	health diseas peopl problem death
	Technology R&D	energi fuel technolog coal effici

Table 5.6 shows the distribution of climate attributes in news coverage from 1987-2012. If one of the 32 attributes was from one of the top three topics terms *and* assigned an LDA proportion score of 0.10 or greater, it received a policy content code for climate change. This threshold is in line with climate studies that employ traditional

human content coding procedures for the presence/absence of a certain category (see for example Liu et al 2008, 2013, 2015; Park et al 2015). What this does is it produces a measure for capturing the diversity of attributes within single news stories and within any given time frame under investigation, by aggregating based on attributes found within single newspaper articles.

Table 5.6: Attributes of Climate Change News Coverage, 1987-2012

Attribute	Count	Percentage
Climate Science	**2169**	**25%**
Carbon dioxide and global warming	256	3%
Climate science scandals	282	3%
Computer modeling and simulation	246	3%
Glacier and sea ice melt	185	2%
Human contribution to global warming	258	3%
Natural climate variation	179	2%
Scientific reports	276	3%
Temperature trends	487	6%
Economics	**796**	**9%**
Competitiveness of US industries	110	1%
Economic benefit/threat	132	2%
Employment ("green jobs")	144	2%
Climate program costs	410	5%
Energy	**1910**	**22%**
Alternatives and renewables	693	8%
Coal	245	3%
Conservation and efficiency	527	6%
Gas and oil	328	4%
Nuclear power	117	1%
Environment	**998**	**12%**
Coastal erosion	164	2%
Endangered species	328	4%
GHG pollution	403	5%
Water conservation	103	1%

Continues next page

Table 5.6 continued

International	**1572**	**18%**
Climate summits	381	4%
Developing nations	154	2%
European Union	257	3%
International treaties	470	5%
Newly industrialized countries	310	4%
Weather & Natural Disaster	**562**	**7%**
Drought conditions	135	2%
Heat/cold waves	210	2%
Natural disasters	217	3%
Other	**603**	**7%**
National Security	246	3%
Public Health	98	1%
Technology R&D	259	3%
	8610	

The total number of attributes in news stories is 8,610. This amounts to an average of 1.8 climate attributes per newspaper article. The climate science umbrella dimension is the most prominent in news coverage with 25%. The second most dominant dimension is energy with 22%. International follows with 18%, environment with 12%, economics with 9%, weather with 7%, national security and technology with 3% each, and public health last with 1%. These results are consistent with other studies on climate news coverage (Liu et al 2008, 2013; Zehr 2000; 2009; Boykoff 2004, 2007; Painter and Ashe 2012; Schmid-Petri et al 2015; Boussalis and Coan 2015). Several unique attributes receive a good amount of coverage in climate news: alternative and renewable energy (8%); conservation and efficiency (7%), temperature trends (7%), international treaties (5%); climate program costs (5%); and greenhouse gas air pollution (5%). For a detailed discussion of attributes in climate news coverage, please refer back to Chapter 4, section two.

Calculating Attribute Diversity

Attribute diversity is an indicator of problem uncertainty, as it captures the ambiguity in the concentration and variety of climate attributes found in news coverage. Strong signals of attribute diversity in the news should amplify problem uncertainty in the muddled space, prioritizing attention to the climate problem. Measuring attribute diversity was a three-step process. First, newspaper articles were content coded for climate change attributes (a discussion of content coding follows this section). Second, each attribute was assigned a proportion by aggregating news coverage by month. For example, if in one month "energy efficiency and conservation" appeared in the news in 5 of 30 total attributes, it would be assigned the value ".16". Third, attribute diversity was calculated using the entropy measure.

The entropy measure was used to calculate the diversity of attributes in climate change news coverage. Entropy – specifically Shannon's H (Shannon and Weaver 1949) – is one of the most commonly-used measures of diversity in multiple fields, including ecology, communications, sociology, information theory, and the policy process (McDonald and Dimmick 2003; Boydstun et al 2014). Recently, Boydstun (2013) used entropy to gauge how the "diversity of discussion" in news coverage of public policy structures subsequent media attention to that policy topic. It has been used elsewhere in studies of jurisdictional competition among congressional committees (Baumgartner et al 2000; Sheingate 2006), policy agenda volatility (Talbert and Potoski 2002), newspaper competition and agenda diversity (Chaffee and Wilson 1977; Lasorsa 1991), and complexity in the policy information environment (Wolfe 2010).

$$\textbf{Shannon's H Entropy: } -\sum_{i=1}^{n}(p(x_i)) * \ln p(x_i)$$

The formula for Shannon's H entropy is above, where x_i represents an attribute, $p(x_i)$ is the proportion of news coverage devoted to that attribute, and $\ln p(x_i)$ is the natural log of that proportion. The entropy score is calculated as an inverse sum of a proportion times its log, over all *n* attributes. As you can see, it captures the number (variety) of attributes in climate coverage and their relative distribution (concentration). Entropy increases as the distribution of coverage becomes more evenly spread among the attributes. For the theory of media signaling, this means that higher entropy scores are associated with strong signals of problem uncertainty. As calculated with entropy, the average attribute diversity score for the monthly series is 1.26, with a standard deviation of 0.35, with a range of 0.36-1.76.

Table 5.7 shows an example of the variety and concentration of attributes in climate coverage for low and high entropy scores. The low score of 0.36 is given in a period where news coverage has just three dimensions – climate science, economics, and international – with one dimension garnering the bulk of media attention (climate science). In this case, the signal of problem uncertainty is relatively weak, as it is clear that climate change is being defined mostly along the science dimension. That is, the attributes that make up the climate problem are not very diverse. Turn to the high entropy score (1.71) and attribute diversity is high, which is a strong signal of problem uncertainty. In this case, climate change is defined along eight dimensions, with several receiving a significant amount of coverage (climate science, energy, economics, environment, international and extreme weather).

Table 5.7: Low and High Entropy Scores for Attribute Diversity

Attribute Category	Low	High
Climate Science	72%	26%
Economics	9%	11%
Energy	-	24%
Environment	-	12%
Public Health	-	1%
International	18%	16%
National Security	-	1%
Extreme Weather	-	10%
Entropy Score	0.36	1.71

A time series for attribute diversity in climate coverage from 1987 to 2012 is displayed in Figure 5.3. As you can see, attribute diversity gradually trends upwards over time. There is a good deal of variance from the beginning of the series until early 2005, where it levels off in a steadier manner. After 2005, attribute diversity varies around new highs. This means that signals of problem uncertainty were relatively strong during this period – and stayed strong. This precedes the uptick in government prioritization of the climate problem via hearings and opening statements starting in 2007. Besides this period, another example is an increase in prioritization activity following a rise in attribute diversity in 1988. The converse relationship is also on display. For example, in 1991 and in 2001, attribute diversity decreased, and so too did prioritization of the climate problem in subsequent time periods.

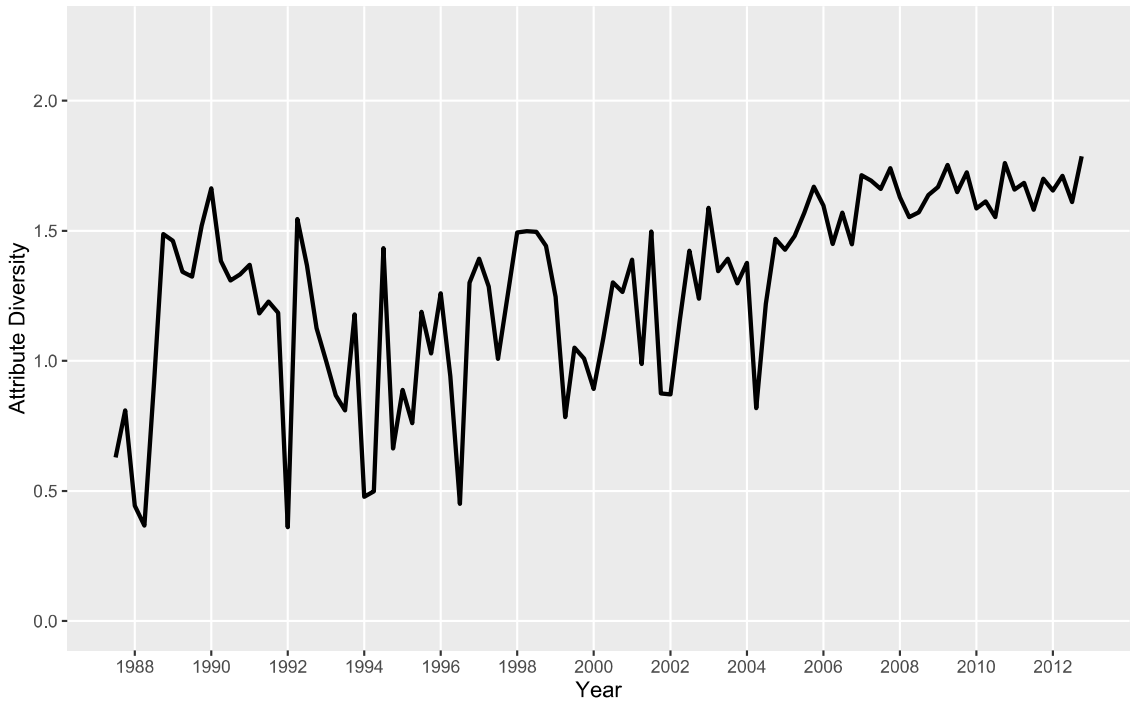

Figure 5.3: The Attribute Diversity of Climate News Coverage, 1987-2012

Calculating Causal Uncertainty

Causal uncertainty is reporting on the uncertainty in the causal relationships that link human behavior with global warming, global warming with climate change, and climate change with its impacts, such as sea-level rise. Coverage of causal uncertainty are media signals that lead to intensifying disputes over problem severity. Clarity in causal stories – connecting an activity with an unwanted outcome that warrants government intervention – has been shown to be a precursor to government problem prioritization, especially in the realm of environmental policy (Stone 1988, 1989; Rochefort and Cobb 1994; Cobb and Elder 1972; Baumgartner and Jones 1993; Scheberle 2005). News reporting on the uncertainties of climate science has been cited as one of the main culprits in causing policy stagnation on climate change in the US (Brunner 1991; Boykoff and

Boykoff 2004, 2007; Antilla 2005; Zehr 2000; Painter and Ashe 2012; Schmid-Petri et al 2015). Even so, none have systematically linked it to how it structures prioritization of the climate problem. This dissertation does just that – it examines the relationship between reporting on climate science and prioritization via congressional hearings and MOC opening statements.

Climate science as a dimension in news coverage is used to measure causal uncertainty.[90] Recall Figure 4.4 from Chapter 4 that diagrams how climate science news coverage creates causal uncertainty. Causal uncertainty in climate news converges around three forms of uncertainty found in reporting on climate science: (1) human contributions to global warming; (2) the causes, consequences, and slope of temperature trends; and (3) climate change impacts (Painter and Ashe 2012; Schmid-Petri et al 2015). These three categories are based on collaborative work between climate scientists and media scholars (see Rahmstorf 2004 for an explanation of the genesis). The pathways to uncertainty created as a consequence of reporting on the causal connections made in climate science studies (arrows in the diagram in Figure 4.4) is both real – reflecting cautious scientific language and internal debates – and overemphasized and manufactured – reflecting politically-motivated actions to cast doubt on the climate problem (McCright and Dunlap 2003, 2010; Oreskes and Conway 2010).

An op-ed by Rep. Lamar Smith (R-TX) in the *Washington Post* published in 2013 is a good example of causal uncertainty in climate news:

[90] Results were validated by coding the full-text of all climate science articles – as derived from the topic models and hand-coded for policy content – with three well-known sentiment dictionaries that are used to measure uncertainty in texts. The correlations ranged from 0.82-0.97 with the dictionary result from Loughran and McDonald (2011), Lexicoder (Young and Soroka 2011) and the WordStat Sentiment Dictionary (2013). In addition, I created my own dictionary using the literature on uncertainty in climate news coverage (Boykoff and Boykoff 2004, 2007; Antilla 2005; Zehr 2000; and Painter and Ashe 2012); the correlation coefficient with 'climate science' articles was 0.91.

> Contrary to the claims of those who want to strictly regulate carbon dioxide emissions and increase the cost of energy for all Americans, there is a great amount of uncertainty associated with climate science. These uncertainties undermine our ability to accurately determine how carbon dioxide has affected the climate in the past. They also limit our understanding of how anthropogenic emissions will affect future warming trends. Further confusing the policy debate, the models that scientists have come to rely on to make climate predictions have greatly overestimated warming.[91]

Causal uncertainty is measured as the proportion of news coverage devoted to the climate science dimension per month.[92] This was derived by dividing the number of climate science mentions by the sum of all dimensions over the period of time. A 'mention' of a dimension is considered to be true if it is derived from one of the top three topic terms from the LDA model *and* is assigned a proportion score of 0.10 or greater. This is the same procedure used in originally coding all articles across all policy content codes. Table 5.8 below displays the attributes of climate science that create causal uncertainty. They are carbon dioxide and global warming; climate science scandals; computer modeling and simulation; sea-level rises; human contribution; natural variation; scientific reports, and temperature trends. As you may recall, the other dimensions besides climate science are economics, energy, environment, international, extreme weather and "other" (national security, public health, and technology R&D).

Table 5.8: The Attributes of Climate Science in News Coverage

Dimension	Attributes
Climate Science	Carbon dioxide and global warming, climate science scandals, computer modeling and simulation, sea-level rises, human contribution, natural variation, scientific reports, temperature trends

[91] May 19, 2013. https://www.washingtonpost.com/opinions/lamar-smith-overheated-rhetoric-on-climate-change-hurts-the-economy/2013/05/19/32cb6d94-bda4-11e2-97d4-a479289a31f9_story.html. (Accessed April 2016).

[92]

For the years 1987 through 2012, there were 2,105 total mentions of climate science, with a mean of 6.8, standard deviation of 6.8, with a range of 0-49 mentions per month. This is an average of 0.44 mentions of climate science per article. As a percentage of news coverage, climate science averaged 28% per month, with a standard deviation of 21% and a range of 0-100%.

Figure 5.X shows a time series of causal uncertainty in news coverage of climate change as a proportion of total coverage from 1987-2012. We can see that the proportion of causal uncertainty varies quite about until around 2007, except for a notable surge in late 2009 and early 2010, which was tied to two science scandals – errors in IPCC reports and Climategate. The long-term trend is a decrease in causal uncertainty in coverage, which is a result of the growing consensus in the scientific and policy communities. Although to be sure, there is much more consensus in the former than the latter. Or, rather, opposing skeptical voices in policy communities are loud enough to keep it a fixture of debate. Notice how it creeps back up again at the very end of the series, which dovetails major developments in cap-and-trade legislation in the House and Senate.

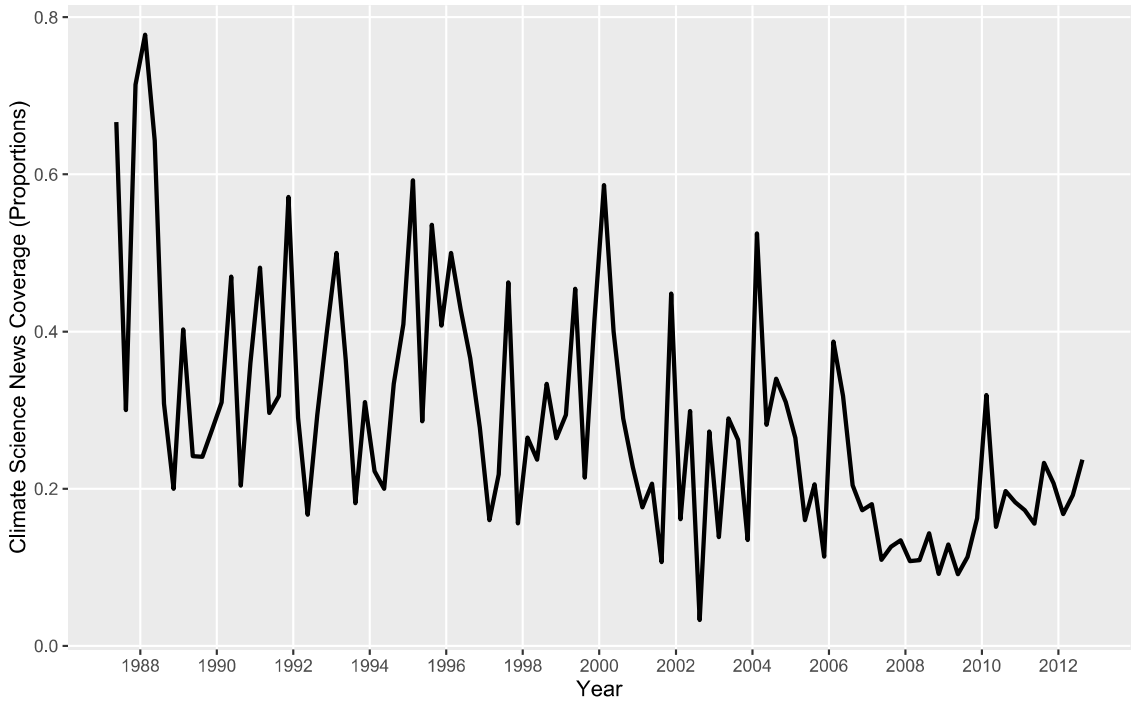

Figure 5.4: Causal Uncertainty in News Coverage of Climate Change, 1987-2012

Control Variables

In addition to the three key independent variables on news coverage, several control variables were collected to account for effects related to objective climate conditions, events, party, chamber, divided government, public opinion, and the economy. The Climate Extremes Index (CEI) controls for objective climate conditions (Karl et al 1996; Liu et al 2011). The CEI is a single, seasonally-adjusted annual indicator that combines data on US temperature trends, precipitation, and tropical storms (hurricanes and cyclones).[93] The CEI for the 1987-2012 data series averages 24.5, with a standard deviation of 7.7 and ranges from 14.3-49.4. Higher values indicate more extreme climate conditions. Following Liu et al (2011), international focusing events are

[93] Data collected from NOAA www.ncdc.gov. For a detailed definition of the CEI, see https://www.ncdc.noaa.gov/extremes/cei/definition

used as a control – 12 events in total coincide with 19% of congressional hearings. This accounts for major climate summits and IPCC reports (see Table A.3 in Appendix A for a list of these major climate events). Republican chamber majority (27% of all hearings), chamber (54% are House hearings), and divided government (61% of all hearings) are political and institutional controls. Stimson's Public Mood was used to control for public opinion.[94] Public mood averaged 60.3, with a standard deviation of 3.0 and a range of 48.9-65.39. Higher scores are associated with a more liberal American public. Finally, changes in gross domestic product (GDP) controls for macroeconomic effects.[95] Changes in GDP averaged 3.9, with a standard deviation of 3.1 and ranged from -4.5-10.4.

Findings: Prioritizing the Climate Problem

As a reminder, two indicators of prioritization are used to assess how news coverage – attribute diversity, causal uncertainty, and volume – effects problem prioritization: congressional hearings and MOC opening statements. This section discusses results for congressional hearings first, MOC statements second. Negative binomial regression was used to model the relationship between prioritization and news coverage, and for disproportionate information-processing and party influence. The dependent variables are event counts. Since event counts are not continuous (i.e. 1,2,3,4…*k*), negative binomial regression rather than linear regression was used to produce more accurate and efficient estimates (King 1989) and to account for overdispersion found in most social processes (Cameron and Trevedi 1986; Long 1997), meaning that the assumption of independence across events is often violated. A simpler Poisson model does not do this; and, not accounting for overdispersion could bias

[94] http://stimson.web.unc.edu/data/
[95] http://www.bea.gov/newsreleases/national/gdp

estimates of standard errors downwards, leading to overly-precise estimates of confidence in coefficients (Cameron and Trevidi 1986).

The first model gauges how Congress prioritizes the climate problem using congressional hearings as the dependent variable (#1-1a). It also investigates disproportionate information-processing (#5) and party influence (#6). To refresh, according to the theory of media signaling previously presented, we should expect the following:

> 1: The number of hearings will increase with attribute diversity and volume of news coverage because they are media signals that focus subsystem attention and mobilize competition over problem definition in light of problem uncertainty and importance.
>
> 1a: The number of hearings will decrease with causal uncertainty because it heightens disputes over causal stories, making it less likely that the policy community will recognize the climate problem as one that warrants debate.
>
> 5: Threshhold effects for climate news signals will vary by coverage type and stage in the problem definition process.
>
> 6: Republicans should be less active in the problem definition process save for giving opening statements at hearings to highlight its uncertainties and/or steer debate towards "nonproblemicity."

Figure 5.5 shows the findings for the first negative binomial model, which estimates the number of congressional hearings as a function of attribute diversity, high levels of causal uncertainty,[96] volume, climate extremes (CEI), international conferences, Republican Congress, divided government, public mood, GDP, time,[97] and previous number of hearings. Data is a time series aggregated at the calendar quarter level, with an *n* of 100. All three media variables – attribute diversity, high climate science, and volume

[96] Threshold effects. High levels of climate science is a dichotomous variable where 1 is assigned if the value at time *t* is greater than the average of *t-1* and *t-2*; 0 if at or below average. This accounts for 46% of the cases.

[97] Number sequence 1-100

– are lagged $k = 2$, which amounts to a six-month lag, consistent with the literature on media effects (see McCombs 2008); and, previous hearings are lagged $k = 1$.[98] (Full regression results are Table A.4 in Appendix A). Looking at the figure, the points on the plot represent coefficient estimates and the bands around the coefficients represent 95% confidence intervals. There is a solid vertical line at the x-axis zero tick mark. Points to the left of this line represent negative coefficient estimates; and, points to the right of the line represent positive coefficient estimates. Confidence bands that do not intersect the zero vertical line are statistically significant.

[98] Results from a Ljung-Box Q-test – 0.54 (p = 0.46) – reveals no significant autocorrelation.

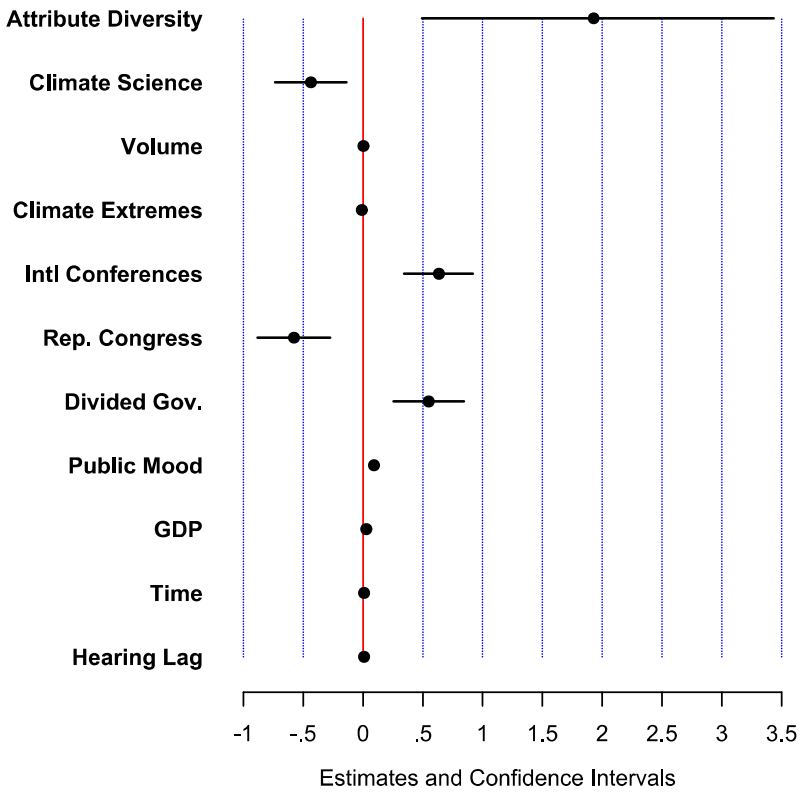

Figure 5.5: Negative Binomial Model: The Number of Hearings per Calendar, 1987-2012

The model using congressional hearings examines the effects of climate news coverage on problem prioritization at the institutional level. Overall, the results support the expectations that news coverage affects problem prioritization – the number of hearings held on climate change varies with media signals. The coefficient estimates for attribute diversity and volume are both positive and statistically significant.[99] That is, the number of hearings increases as attribute diversity and volume grow. These results

[99] It is hard to tell that volume is positive or statistically significant. The volume estimate is 0.003 with a z-value of 2.52, so the coefficient and its confidence band are comparatively small. Recall that volume is a variable composed of whole numbers, some of which are relatively large (i.e., 200). The size of the parameter estimate reflects this and is taken into account when interpreting effects with predicted counts.

support the expectation that these characteristics of news coverage drive problem prioritization via holding hearings to debate the climate problem.

The coefficient estimate for causal uncertainty is negative and statistically significant. This supports the expectation that the number of hearings is negatively associated with uncertainty in causal stories. The number of hearings decreases as a function of causal uncertainty in the news. Meaning, coverage of causal uncertainty constrains policy debates on the climate problem. Recall that causal uncertainty in this model is a threshold variable – it is a dichotomous measure that captures strong (i.e., above a two-quarter moving average) media signals of causal uncertainty. This supports the expectation that some media signals will be subject to disproportionate information-processing. In this case, policy communities underreact to media signals of causal uncertainty until it "breaks through" the messy information environment that characterizes climate change's muddled problem space with above average levels of coverage. That is, the number of hearings decreases when causal uncertainty in climate reporting is at above-average levels.

Turning to the coefficient for Republican congress, it is negative and statistically significant. This provides support for the expectation that Republicans are less active in the climate problem definition process – prioritization being one aspect of it. This is consistent with the literature on concerted efforts by conservatives to oppose government action to attend to and alleviate the climate problem (McCright and Dunlap 2003; Oreskes and Conway 2010). Republican-majority congresses are less likely to hold hearings to examine the climate problem.

In regards to the other control variables, international conferences, divided government, public mood and time are all positive and statistically significant. Congress holds more hearings on climate change to debate the potential policy impacts of

international conferences (Liu e al 2011; Painter and Ashe 2011). More hearings are likely to be held in times of divided government and when the American public is more liberal. In terms of time, the findings suggest that over the years the number of hearings increases. Previous hearings have no statistically significant impact on the number of hearings. This suggests that climate hearings may be more a function of politics and attention to problem indicators – such as media signals – and less of institutional inertia. This is counter to many other studies that have demonstrated policy attention inertia (Baumgartner and Jones 1993; Wood and Peake 1998; Soroka 2002). The muddled problem space of climate change may account for this, whereas typical issues do not reside in a policy environment with such heightened levels of uncertainty. The climate extremes variable has no discernable impact on congressional hearings. This supports the notion that real-world conditions as problem indicators are filtered through political institutions, such as the media (Jones and Baumgartner 2005; Baumgartner and Jones 2015).

It is difficult to interpret the effects of independent variables in negative binomial regression looking solely at the parameter estimates and their confidence intervals. Since this is the case, Figure 5.6 and 5.7 show predicted counts of hearings for attribute diversity, volume, and low-high levels of causal uncertainty. The first two are line graphs because they are continuous independent variables. The effect of causal uncertainty is displayed in what is called a ropeladder plot, on account of it being a dichotomous variable. Figure X shows the predicted number of hearings held on climate change for increasing values of attribute diversity (top) and volume (bottom).

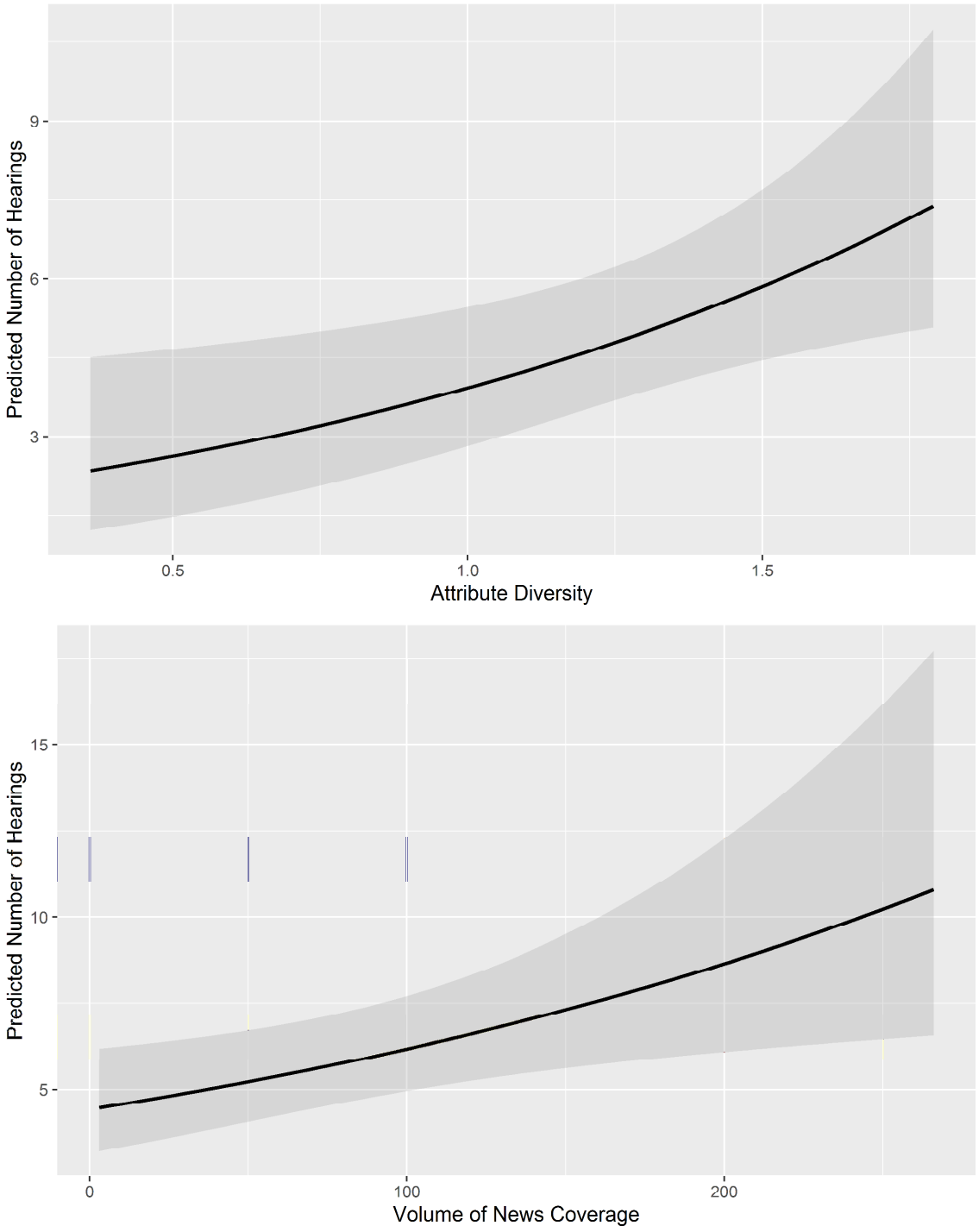

Figure 5.6: Predicted Number of Hearings for Increasing Values of Attribute Diversity and Volume of News Coverage

The solid black line represents the predicted number of hearings and the gray shading around it its 95% confidence bands. Keep in mind that the average number of hearings held per calendar quarter is 3.9. The first thing to notice in Figure X is that the number of hearings grows as both attribute diversity and volume of coverage increase. In the case of attribute diversity (top), the predicted number of hearings increases from 2.3 to 7.4 as attribute diversity in the news moves from a low of 0.36 to its maximum score of 1.7 – an over two-fold increase in hearings. Turning to volume (bottom), the predicted number of hearings more than double from 4.5 to 10.8 as volume of coverage moves from a low of 3 articles to its high of 266 articles.[100] As the slope of the line indicates, attribute diversity and volume exhibit similar effects on mobilizing attention to climate change.

Figure 5.7 displays the predicted number of hearings when causal uncertainty in the news is below average (left) and when it is above average (right). The points represent the number of hearings and the vertical band that runs through it its 95% confidence level. When climate news coverage shifts to other dimensions other than causal uncertainty in climate science, the predicted number of hearings is above average, at 5.2. When signals of causal uncertainty break through the muddled problem space with higher than average levels of reporting, the predicted number of hearings drops to 3.3 – a 64% decrease.

[100] Recall that the unit of analysis for this model is calendar quarter, which summed the number of hearings per month.

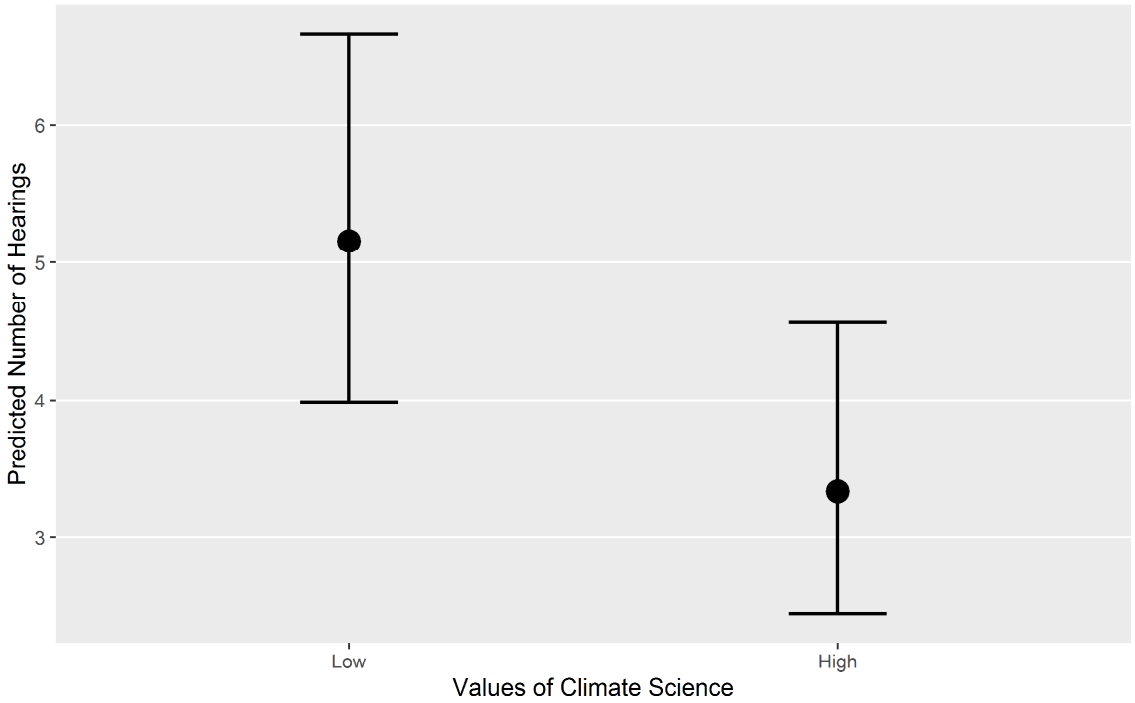

Figure 5.7: Predicted Number of Hearings for Low and High Levels of Causal Uncertainty in News Coverage

The model using congressional hearings examines the effects of climate news coverage on problem prioritization at the institutional level. The findings show support for news coverage driving institutional prioritization of the climate problem. We should expect climate news to impact how individuals prioritize it as well *after* it is on the government agenda, i.e. once a hearing has been scheduled. To investigate this, I tallied the number of opening statements made by Members of Congress (MOC) at the beginning of each hearing. When giving opening statements, MOCs are acting as policy brokers for subsystems competing to steer policy debates on climate change (Sabatier and Jenkins-Smith 1993; Kingdon 1995). Opening statements are a vehicle for casting an image over and making claims about a policy problem (Brown 2004). In addition to

testing for threshold effects (#5 above) and party influence (#6 above), we should expect the following:

> 2: The number of opening statements will increase with all three aspects of news coverage – attribute diversity, causal uncertainty, and volume – because they will induce policy brokers to compete over defining climate change in light of problem uncertainty, heightened scrutiny of problem seriousness, and increases in importance.

Figure 5.8 shows the findings for a negative binomial model that estimates the number of opening statements as a function of attribute diversity, causal uncertainty, high volume,[101] climate extremes (CEI), international conferences, Republican majority, U.S. House, public mood, GDP, and time. The unit of analysis is the hearing. The date of the first session was used to create six-month lags for the three independent variables on climate news. (Full regression results are in Table A.5 in Appendix A). As before, the points represent coefficient estimates and the bands are 95% confidence intervals. Points that fall to the left of the solid vertical line at the zero tick mark represent negative coefficients; and, those on the right represent positive coefficients. Confidence bands that do not intersect zero are considered statistically significant.

[101] High volume is a dichotomous variable where 1 is assigned if the value at time t of hearing *k* is greater than the average of t-1 (*k*-1) and t-2 (*k*-2); 0 if at or below average. High volume occurs in 52% of the cases.

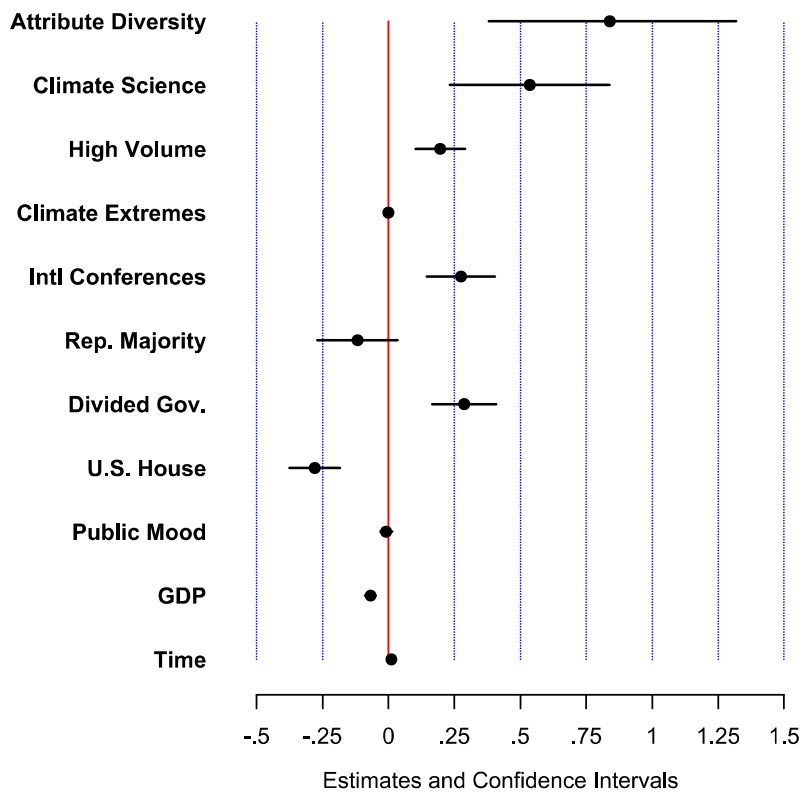

Figure 5.8: Negative Binomial Model: The Number of Opening, 1987-2012

The overall results for attribute diversity, causal uncertainty, and high volume support the expectations that news coverage will be positively associated with the number of opening statements made by Members of Congress. The coefficients for all three variables are positive and statistically significant. It also provides additional support for the expectation that problem prioritization is affected by climate news coverage. These findings suggest that climate news mobilizes policy brokers to make opening statements to influence how the climate change problem definition is characterized.

Looking at the three variables individually, these results demonstrate support for the notion that increases in attribute diversity as a media signal amplifying problem uncertainty provides policy brokers an opportunity to compete over which attributes

define climate change. In regards to causal uncertainty, the positive relationship indicates that the media signal about uncertainty in climate change's causal relationships moderates how policy brokers prioritize resources devoted to steering policy debates by making claims about the climate problem. Finally, the results for volume suggest that policy brokers will be moved to prioritize attention to publically weighing in on the debate in response to clear signals that the climate problem is highly salient. This provides further support for the notion that some media signals will be subject to the vagaries of disproportionate information-processing.

Turning to the control variables, the estimate for Republican majority is neither in the expected direction nor is it statistically significant. We can see that international conferences and divided government are positively and statistically related to the number of MOC opening statements. The dynamics that underpin these results are at least partially related. The president plays a leadership role in climate policy by being the chief executive over the EPA and Department of Commerce, who make rules and regulations about greenhouse gas emissions. We should expect MOCs to compete with the president over climate policy, especially given its partisan nature. As for international conferences, this is again the purview of the president, whose climate treaties must be ratified by the Senate. International conferences are also catalysts for contentious policy debates over climate science (Boykoff and Boykoff 2004, 2007; Liu et al 2011), which mobilizes fierce competition among policy brokers.

House-held hearings and GDP both have negative and statistically significant estimates. The explanation for the House estimates dovetails with international conferences: the differential is likely explained by the Senate's obligations regarding treaties. The number of statements decrease as GDP grows, which suggests that policy brokers know that the argument that climate policy is too costly, a common thread in

climate debates, may have less punch with improving economic conditions. Time as a variable is positive and statistically significant at the 0.1 level. This means that the number of witness statements made at hearings decreases over the years. The frequency of hearings toward the end of the 1987-2012 period may account for this. For example, the same policy broker that made a statement at a hearing in June 23, 2007 may not feel it advantages to them to make another at a hearing held on July 5th.

The predicted number of statements are presented in Figures 5.9 and 5.10 to better interpret the effects of the three media variables – attribute diversity, causal uncertainty, and high volume. Recall that line graphs are used to explore the impact of continuous variables and ropeladder plots are used for the dichotomous volume variable. Figure X shows the predicted number of statements during climate hearings for increasing values of attribute diversity (top) and volume (bottom).

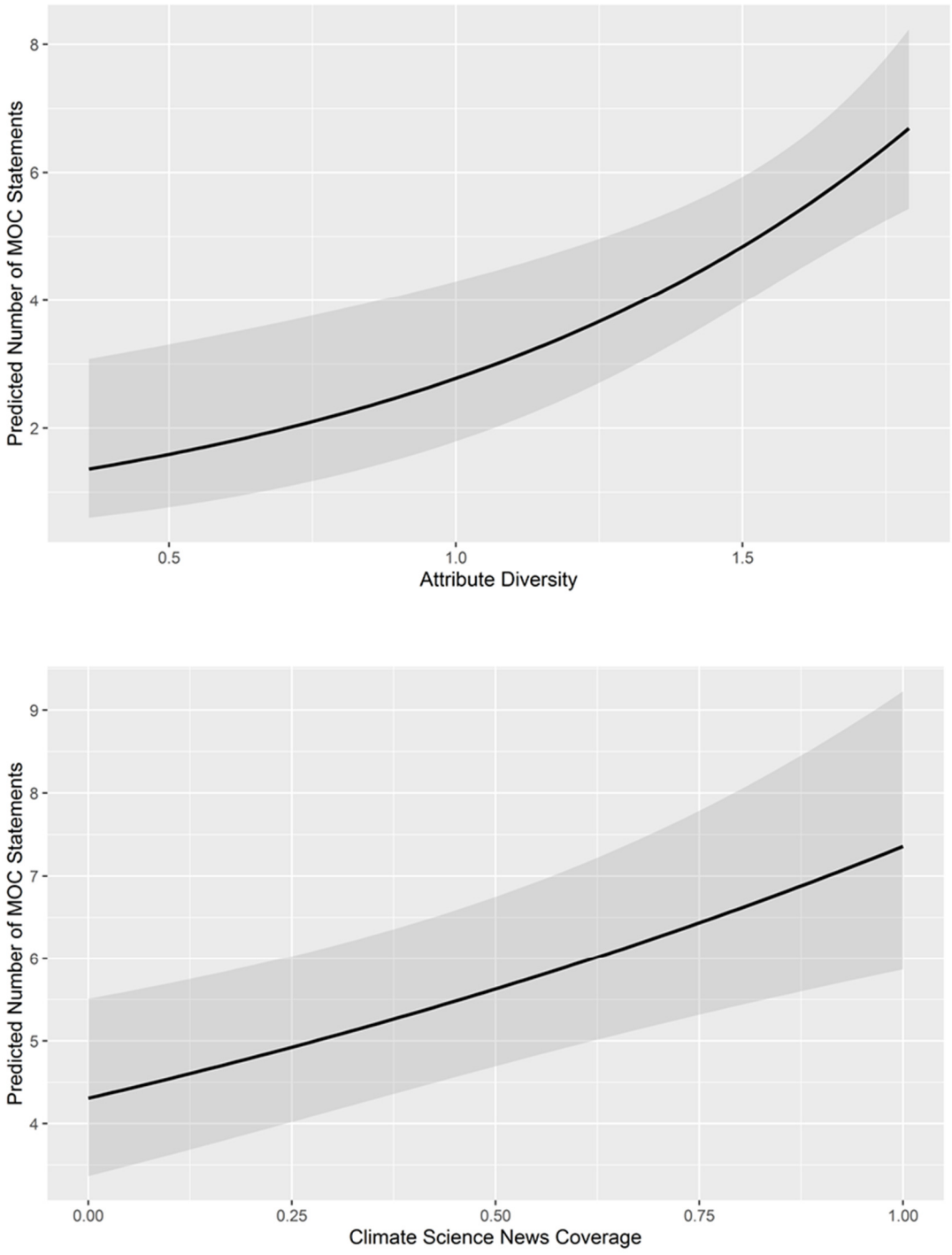

Figure 5.9: Predicted Number of Statements for Increasing Levels of Attribute Diversity and Causal Uncertainty in News Coverage

The solid black line represents the number of statements, and the gray shading its 95% confidence interval. Keep in mind that the average number of statements is 4.4 per hearing. The first thing notice is that the number of predicted statements increases as both attribute diversity and causal uncertainty move from low to high values. Also notice that the steepness of the slope accelerates in the case of high levels of attribute diversity compared to causal uncertainty. In the graph on attribute diversity (top), the predicted number of statements increases nearly five-fold from 1.4 to 6.7 statements per hearing as attribute diversity grows from its lowest to its highest value, sending stronger and stronger signals of problem uncertainty. The overall effect of causal uncertainty in climate science reporting is substantial, but not as pronounced (bottom graph). The number of statements nearly doubles from 3 to 5.1 per hearing as the proportion of coverage devoted to climate science grows from its lowest to its highest value. This suggest policy brokers respond as news coverage of causal uncertainty grows, sending signals that intensify uncertainty in causal relationships and calling into question current notions of problem severity.

Figure 5.10 displays the predicted number of statements when the volume of news coverage is below average (left) and above average (right). As before, the points represent the number of statements and the vertical lines their 95% confidence bands. When the volume of climate news shifts from below to above average values, the predicted number of hearings increases approximately 20% from 4.4 to 5.3. This demonstrates that policy brokers respond to large increases in news volume.

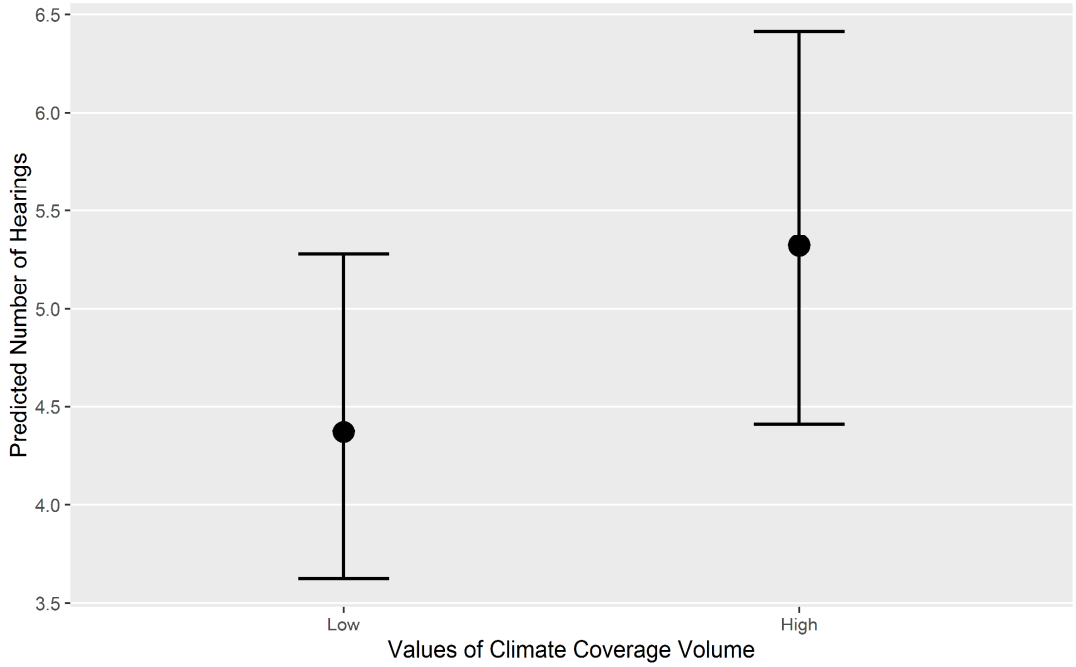

Figure 5.10: Predicted Number of Hearings for Low and High Levels of News Volume

Summary

To test the theory of media signaling, this chapter examines how attribute diversity, causal uncertainty, and volume of news coverage influence how policy communities prioritize the climate problem. Prioritizing policy attention is a necessary precursor to coming up with its solutions (Jones and Baumgartner 2005). Does news coverage influence problem prioritization, and if so, how? This chapter uses two indicators of prioritization – congressional hearings for policy communities as a group and the number of opening statements made at these hearings as a proxy for policy brokers prioritizing climate change.

The results suggest that attribute diversity and volume moderate problem uncertainty and disputes over severity and are thus important factors in prioritizing the climate problem. The number of congressional hearings and opening statements increase

alongside growth in these media signals. Causal uncertainty in climate news lowers the priority of the problem among policy communities as a group, making it less likely to be up for debate on the policy agenda. But once it *is* the subject of formal debates, causal uncertainty seems to prioritize the climate problem among policy brokers. This chapter also demonstrates support for disproportionate information-processing of signals coming from news coverage. These findings imply that only clear and strong signals of causal uncertainty influence problem prioritization by way of congressional hearings. Policy brokers seem only to respond when volume of news coverage is a clear and strong media signal as well. The results from this chapter provide strong support for the role of the media in problem expansion. The next chapter looks at how climate news influences the other end of the problem definition process – the generation of policy solutions.

Chapter 6: Limiting Climate Solutions

> Climate change is due to a combination of factors, including natural cycles and human activity. *But scientists still disagree about how much each of these factors contributes to the overall climate change the Earth is experiencing. But understanding the causes of climate change is critical to developing a serious and effective solution*. … President Obama and the Environmental Protection Agency recently released carbon pollution standards for new power plants that, even the EPA admits "will result in negligible CO2 emission changes." … *A better approach is to place a higher priority on fundamental research that will enable new energy technologies to become more cost-effective*.[102]

Representative Lamar Smith (R-TX), Chairman of the House Committee on Science, Space, and Technology, engaged in a media blitz in 2013 to counter President Obama's Climate Action Plan, which contained provisions for the first set of government standards on carbon pollution from power plants. The above excerpt from his op-ed in *The Hill* illustrates a common argument used in policy debates to limit the comprehensiveness of climate solutions. Opponents of large-scale solutions to reduce greenhouse gases – such as carbon caps as in the above or a carbon tax – highlight uncertainties in the science that establishes causal connections between human activities, greenhouse gases, and climate change impacts to steer debate towards more limited, incremental solutions. In this example, Smith advocates for funding cost-effective new energy technologies instead of carbon caps on power plants in light of scientific disagreements on the causes and consequences of climate change. As a strategic policy entrepreneur, Smith is also using this as an opportunity to advocate for climate solutions

[102] Italics added. Rep. Lamar Smith (R-TX) in *The Hill*, October 1, 2013. http://the hill.com/opinion/op-ed/325971-extreme-weather-isnt-linked-to-climate-change. (Accessed November 2013).

that would benefit an important constituency in his home state – the Texas Clean Energy Project, a coal gasification power plant with cutting-edge carbon capture technologies.[103]

The climate problem has been a fixture in policy debates since at least 1988, but the U.S. – and especially Congress – has been slow to respond by considering large-scale policy solutions, such as cap-and-trade or a carbon tax. In 2000, President Clinton said in his State of the Union address to Congress that "[i]f we fail to reduce the emissions of greenhouse gases, deadly heat waves and droughts will become more frequent, coastal areas will flood, and economies disrupted."[104] It was not until 2007 that the House and Senate seriously considered several cap-and-trade and some carbon tax legislative proposals. A cap-and-trade bill passed the House in 2009, but its counterpart in the Senate stalled in floor debates and was eventually abandoned.

In place of comprehensive solutions, Congress overwhelmingly debates and legislates incremental approaches to reducing greenhouse gases, such as conservation and efficiency or alternative and renewable energy initiatives. Why is this the case? What accounts for this slow momentum toward policy solutions on the climate problem? This chapter examines how news coverage – attribute diversity, causal uncertainty and volume – structures debates on climate solutions, limiting government intervention to more cautious approaches to tackling the problem. This is the other half of the dual dynamics that are at play for how climate news structures policy debates. We saw in the previous chapter that news coverage influences how congressional committees and Members of Congress acting as policy brokers prioritize the climate problem. It is in this capacity that

[103] The DOE had invested $450M into the Texas Clean Energy Project as of 2014 http://www.texascleanenergyproject.com/ (Accessed April 2016).
[104] Retrieved from the Policy Agenda's Project data series on State of the Union Speeches http://www.policyagendas.org/page/datasets-codebooks#state_of_the_union_speeches. (Accessed July 2013).

media signals are responsible for problem expansion; it focuses attention and moderates our understanding of what defines the climate problem.

But on the other side of the climate problem are the solutions attached to it. And it is here where media signals are responsible for solution containment. The nature in which climate change is covered in the news – the degree of attribute diversity and causal uncertainty – leads to amplifying already intense policy debates about problem uncertainty – which attributes define the climate problem - and questions of problem severity due to uncertainties surrounding why climate change is happening and what are its effects. In light of so much uncertainty, news coverage at once paralyzes debates about comprehensive solutions, and mobilizes policy debates instead toward incremental approaches to fixing the climate problem. The remainder of this chapter is divided into two sections. The first section provides a review of media signaling in the muddled problem space that leads to solution containment. The second section presents the research design and findings from two models – (1) the number of large-scale and (2) incremental solutions in policy debates – that examine how news coverage structures policy debates on climate solutions away from large-scale approaches toward more limited approaches to addressing the problem.

LIMITING SOLUTIONS BY AMPLIFYING UNCERTAINTY IN THE MUDDLED PROBLEM SPACE

> Believe it or not, the main scientific and policy institutions responsible for climate change in the international arena do not even agree on what the phrase 'climate change' actually means.[105]

> Contrary to the claims of those who want to strictly regulate carbon dioxide emissions and increase the cost of energy for all Americans, there is a great amount of uncertainty associated with climate science. These uncertainties undermine our ability to accurately determine how carbon dioxide has affected the climate in the past. They also limit our understanding of how anthropogenic emissions will affect future warming trends. Further confusing the policy debate, the models that scientists have come to rely on to make climate predictions have greatly overestimated warming.[106]

How a problem is defined determines its range of solutions and hence whether or not policy in that area changes a great deal – i.e. large-scale punctuations – or if it evolves in a more incremental fashion (Baumgartner and Jones 1993; Jones and Baumgartner 2005). This section provides an overview of how media signals interact with the muddled problem space to result in solution containment of the climate problem. By solution containment I mean limiting policy debates to incremental approaches to alleviating the unwanted impacts of climate change and discouraging discussions of comprehensive solutions that would lead to large-scale policy change. Table 6.1 provides descriptions of the media signals investigated in this dissertation – attribute diversity, causal uncertainty, and volume.

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[105] Roger Pielke, Jr. in *The Climate Fix* (2010, p. 143)

[106] Rep. Lamar Smith (R-TX) in a *Washington Post* op-ed, May 19, 2013. https://www.washingtonpost.com/opinions/lamar-smith-overheated-rhetoric-on-climate-change-hurts-the-economy/2013/05/19/32cb6d94-bda4-11e2-97d4-a479289a31f9_story.html. (Accessed April 2016).

Table 6.1: Three Media Signals of Climate Change

Media Signal	Description
Attribute Diversity	Ambiguity in the variety and concentration of the dimensions found in climate change news coverage. This leads to amplifying problem uncertainty.
Causal Uncertainty	Reporting on the uncertainty in the causal relationships that link human behavior with global warming, global warming with climate change, and climate change with its impacts. This leads to intensifying disputes over problem severity.
Volume	The amount of attention the media devotes to climate change. This increases the salience and importance of the climate problem.

The first quote at the beginning of this section is from Roger Pielke, Jr., Professor of Environmental Studies at the University of Colorado, who specializes in climate policy and politics. It illustrates the potential influence of attribute diversity in news coverage – it amplifies uncertainty about how climate change is defined or "what it even means." This heightened problem uncertainty is a characteristic of complex policies in the muddled problem space. The problem known as "climate change" has multiple ill-defined attributes attached to it – broadly, the economy, national security, science, energy, etc. Policy communities compete over which attributes best define the climate problem to delineate the solutions attached to it. Attribute diversity is defined as ambiguity in the variety and concentration of the dimensions used to frame the climate problem in the news. Signals of attribute diversity from climate coverage amplify the existing problem uncertainty in the muddled space. Because comprehensive solutions require large shifts in resource allocation, government intervention, and regulatory changes, they are not likely when problem uncertainty is relatively high. Instead, if policy communities cannot agree on "what it even means," politically feasible solutions to climate change will be smaller-scale in nature – i.e. incremental.

The second quote at the beginning of this section is from an op-ed written by Rep. Lamar Smith (R-TX), Chairman of the House Committee on Science, Space, and Technology, in 2013. It is at once both an example of causal uncertainty in news coverage and an illustration of how this type of media signal colors policy debates on climate solutions. Causal uncertainty in news coverage is reporting on the uncertainty in causal relationships that link human behavior with global warming, global warming with, climate change, and climate change with its impacts. This leads to intensifying disputes over problem severity, which are a fundamental characteristic of complex problems in the muddled space.

In the muddled space there is a great deal of contention over just how severe is the climate problem. This is largely a result of the uncertainty that underlies the complexity of causal connections that link human behavior with global warming and global warming with deleterious climate change effects. At its simplest, a problem definition is a cause-and-effect relationship that is also solvable and worth solving (Dery 1994). Rep. Smith emphasizes causal uncertainties in his *Post* op-ed, writing that "there is a great amount of uncertainty associated with climate science" and then goes on to list many points of uncertainty and how they "confuse" the policy debate. The theory of media signaling suggests that growing causal uncertainty in news coverage will decrease the likelihood of large-scale climate solutions such as cap-and-trade – for political reasons and for policy tool appropriateness. Instead, incremental approaches to solving the climate problem will be the preferred mode in policy debates in light of causal uncertainty.

Volume as a media signal of importance is a little more straightforward than attribute diversity or causal uncertainty in news coverage. Volume is the amount of attention the media devotes to climate change. This is a media signal that increases the

salience – the importance – of the climate problem and should mobilize policy communities around comprehensive solutions to fix it. Media attention in the policy processes literature has a strong relationship with large-scale, punctuated policy change (Baumgartner and Jones 1993; Jones and Baumgartner 2005; see Van Aelst and Walgrave 2006 for a review).

RESEARCH DESIGN

How does news coverage produce solution containment, discouraging policy debate on large-scale solutions and instead encouraging incremental approaches to fixing the climate problem? The theory of media signaling suggests that three aspects of climate news – attribute diversity, causal uncertainty, and volume – send signals to policy communities about problem uncertainty, problem severity, and just how important or salient is the problem. These signals heighten uncertainty and intensify policy disputes that already exist in the muddled problem space of climate change policy debates. The previous chapter demonstrated how these aspects of news coverage structure prioritizing the climate problem. This chapter looks at the other end of the climate problem – its solutions – to investigate the link between news coverage and the scope of climate solutions.

Data: Large-Scale and Incremental Solutions in Climate Policy Debates

The two dependent variables in this chapter used to examine how news coverage structures the generation of climate solutions in policy debates are the number of (1) large-scale solutions and (2) incremental solutions to climate change per hearing. What differentiates large-scale from incremental climate solutions, specifically those that reduce carbon emissions? Large-scale solutions require large shifts in resource allocation, government intervention, and bureaucratic rules and regulations (Davenport 2007b).

Legislating large-scale solutions requires devoting massive resources and political capital to coordination, bargaining, and tradeoffs. In the parlance of the policy processes literature, these are punctuated changes to climate policy. Incremental – or rather limited – solutions make no or little such demands. This type of solution is akin to making updates or adjustments to the status quo (Baumgartner and Jones 1993; Wildavsky 1964; Truman 1951). As opposed to punctuated policy change, these solutions feed into stability and enforce equilibrium policymaking.

Table 6.2 provides descriptions of the large-scale and incremental solutions to the climate problem. Cap-and-trade and its alternative, the carbon tax, are the two large-scale climate solutions (Cullenward 2010). Cap-and-trade is a market-based approach that sets total carbon allowances – the "cap." Carbon credits are then traded by emitters on the free market. A carbon tax is a price set on each ton of carbon emitted, and emitters throughout the economy are charged, such as a tax applied to the purchase or use of fuels. It does not guarantee emission reductions as does cap-and-trade, rather its price signal is intended to incentivize "a market response" away from greenhouse gas intensive behaviors and forms of energy.[107]

[107] World Bank's Putting a Price on Carbon with a Tax publication
http://www.worldbank.org/content/dam/Worldbank/document/SDN/background-note_carbon-tax.pdf

Table 6.2: Definitions for Large-Scale and Incremental Climate Solutions

Solution Type	Definition
Large-Scale	
Cap-and-Trade	Also known as "carbon trading," it is a market-based policy instrument that sets a limit on total allowed emissions. Carbon credits -- "the legal right to emit 1 ton of carbon dioxide per year" -- are created that equal the total amount of emissions. Credits are either sold or given to companies gratis, who are then allowed to trade them among each other.[1]
Carbon Tax	A price (tax) is set on carbon -- such as $10 per ton -- and emitters throughout the economy are charged.[1]
Incremental	
Conservation and Efficiency	Conservation and energy efficiency reduce carbon emissions by changing behavior (e.g. turning out lights) and through technologies aimed at providing the same or better service using less energy (e.g. energy efficient kitchen appliances). It is one of the cheapest policy solutions for reducing carbon emissions.[2]
Renewables and Alternatives	No and low-carbon sources of electricity and fuel from existing, ongoing, and replaceable natural sources (e.g. wind and solar; corn for ethanol).[3]
Carbon Sequestration	Technologies to capture carbon from industrial and power plant emissions and store it in geological formations (sequestration). Cost-effective technologies for its wide-spread application are still being researched and developed.[4]
Voluntary Reductions	Programs that assist and incentive voluntary reductions of greenhouse gases by the private sector (e.g. ENERGY STAR, The Green Power Partnership, Center for Corporate Climate Leadership).[8]
Carbon Offsets	A unit of carbon dioxide (or equivalent) is reduced for every unit of carbon emissions produced (e.g. planting trees or buying renewable energy credits).[1, 5]
Mass Transit	Public transportation (i.e. buses, trains, subways) as an alternative mode of travel to reduce carbon emissions from burning gasoline in single-occupancy vehicles.[6]
Technology R&D	Engineering technologies developed as "intentional, large-scale manipulation of the environment" to counterbalance global warming, for example injecting aerosols into the atmosphere to act as "sun shades."[7]

[1]Cullenward (2010, pp. 204-205); [2]Chang, Rosenfeld, and McAuliffe (2010); [3]Kammen (2010); [4]Hawkins (2010); [5]World Resource Institute www.wri.org (accessed March 2016); [6]https://www3.epa.gov/climatechange/ghgemissions/sources/transportation.html (accessed March 2016); [7] Keith (2010); [8]https://www3.epa.gov/climatechange/EPAactivities/voluntaryprograms.html (accessed March 2016).

There are seven prominent incremental climate solutions to reducing greenhouse gases, particularly carbon dioxide, in climate policy debates (Schneider et al 2010; Dryzek, Norgaard and Schlosberg 2011). Table 6.2 provides descriptions of these as well. Conservation and efficiency reduce emissions by changing behavior (e.g. turning out lights) and through technologies developed for the purpose of providing the same or better service, but with less energy (e.g. energy efficient appliances, lightbulbs) (Chang, Rosenfeld, and McAuliffe 2010). Renewables and alternatives are no and low-carbon sources of electricity and fuel from existing and replaceable natural sources, such as wind, solar, and corn for ethanol (Kammen 2010). Carbon sequestration is technology

that captures carbon emitted from high-volume sources, such as industry or power plants, and stores it underground (Hawkins 2010). Voluntary reductions are programs that assist and provide incentives for voluntarily reducing carbon emissions, such as the EPA's ENERGY STAR.[108]

Carbon offsets compensate for every unit of carbon emitted by reducing it elsewhere (Cullenward 2010; World Resources Institute[109]), for example, by planting trees or buying renewable energy credits. Mass transit is public transportation alternatives to single-occupancy, internal-combustion engine, gasoline-dependent vehicles.[110] And, technology R&D is engineering technologies developed to manipulate the environment to reduce global warming. An example of this is known as "sun shade" technology, which is the injection into the atmosphere of aerosols that block solar radiation to reduce warming (Keith 2010). While not specifically aimed at *reducing* carbon dioxide emissions, it counters the need for reducing them and is often brought up as an alternative in tandem with the other incremental solutions (Bracmort and Lattanzio 2013; Schneider et al 2010).

Data on large-scale and incremental solutions were collected from 406 congressional hearings on climate change held from 1987-2012. These hearings were collected from *ProQuest* with a keyword search on a standard set of terms for research on climate change.[111] Non-relevant hearings were eliminated by reading *ProQuest*'s descriptions and the first few pages of each borderline hearing. Results were further verified by cross-referencing these hearings with the Policy Agendas Project's series on

[108] https://www3.epa.gov/climatechange/ghgemissions/sources/transportation.html (accessed March 2016)
[109] www.wri.org (accessed March 2016)
[110] https://www3.epa.gov/climatechange/ghgemissions/sources/transportation.html (accessed March 2016)
[111] These terms are "greenhouse gases", "greenhouse effect", "global warming", and "climate change." This set of terms is used in many media and policy studies of climate change. See for example Liu et al (2011, 2015), Boykoff and Boykoff (2004, 2007); Park et al (2010); Fisher et al (2013).

congressional hearings from policy content codes 705 (global warming and air pollution) and 1902 (international treaties and resource agreements).[112]

As discussed in the previous chapter on problem prioritization, policy debates in hearings are an indicator of subsystem competition over defining policy problems and delineating their solutions (Baumgartner and Jones 1993; King 1997; Worsham 1997; Jones and Baumgartner 2005). Often in the policy processes literature we analytically separate problems from solutions, but in practice we know that individuals and deliberative bodies often engage with problems and solutions at the same time (Jones 1994b; Newell and Simon 1972; Kingdon 1995; Cohen, March and Olsen 1972). This is because problem definitions structure solutions sets; and, because sometimes policy entrepreneurs seek to apply their preferred solutions from one policy to another policy problem. We see this anecdotally with Wirth's – the Senate's "point man" on the Energy and Natural Resources Committee – statement that advocates of energy conservation must "ride the global warming [wave]" (Stanfield 1988).

Content Coding Policy Debates in Hearings for Climate Solutions

The full-text of opening statements and witness testimonies from these 406 congressional hearings were content coded for large-scale and incremental solutions using a two-step machine-human hybrid approach to analyzing political texts. There were 1,818 statements and 2,491 witness testimonies. The combination of opening statements and testimonies – referred to collectively as "statements" from here on out – totaled 4,309 and averaged 10 per hearing, with a standard deviation of 6, and ranged from 1 to 36.

[112] www.polcyagendas.org. The Policy Agendas Project maintains a data series on congressional hearings that is coded for policy content using a consistent and reliable coding scheme that is backwards compatible, allowing for comparisons over time. The full coding system can be access here: http://www.policyagendas.org/page/topic-codebook. For examples of peer-reviewed research using Policy Agendas data, see Baumgartner and Jones (1993, 2015), Jones and Baumgartner (2005), Jones and Baumgartner (2009), Baumgartner et al (2011), Wolfe (2012).

The first step to content coding was estimating an automated topic model on the statements. After checks for robustness,[113] the topic terms – clusters of words that best represent each topic – were coded for solution type based on the definitions in Table X.X above.

Automated topic models group words that are semantically, i.e. thematically, related. This produces the "topic terms" to which humans assign substantively meaningful content codes. One of the advantages of this method is that these groups of words can share words, which better reflects real-world political texts. For example, "carbon" can be grouped with "efficiency" and "cap-and-trade." Topic models applied to political texts have been used to analyze newspaper coverage of terrorist threats (Bonilla and Grimmer 2013), attribute uncertainty brought on by a financial crisis (Shaffer et al 2015), the issue definitions that structure policy debates on spent nuclear fuel (Nowlin 2015), the policy and scientific frames used in reports issued by conservative think tanks (Boussalis and Coan 2015), and agendas found in Senate press releases (Grimmer 2010) and floor speeches (Quinn et al 2010).

As in the chapter on problem prioritization, *latent Dirichlet allocation* (LDA) (Blei, Ng, and Jordan 2003; Blei 2012) is the specific topic model that was used to analyze hearing statements for climate solutions. This approach assumes that K topics structure a collection of documents.[114] Not all K topics are in each individual document D_i – hearing statements here. For example, we know from the literature on climate solutions that there are two large-scale solutions and more or less seven types of incremental solutions (Schneider et al 2010; Dryzek, Norgaard and Schlosberg 2011). We

[113] Robustness is defined as the stability and validity of topic terms for small changes in the number of topics estimated (Blei 2012; Grimmer and Steward 2012; Grimmer and King 2010). The final model estimated 66 topics. After "junk" topics were removed, 57 remained.

[114] The number of topics and the topic structure depends on the research question of the investigator (Blei 2012).

expect to find all of these represented in the entire collection of statements from 1987-2012. However, we do not expect a single statement made by a Member of Congress to contain all 11 types of solutions in any meaningful fashion. The topic model LDA estimates K topics for the entire collection of documents D and assigns a proportion to each K_i topics for each document D_i. In other words, this approach assigns each statement a proportion "score" for each K_i topics that structure all documents D. For example, Wirth's entire statement about energy conservation would be assigned a large proportion to the set of terms that best represent "conservation and efficiency" – say .60+ – and much smaller proportions to all of the remaining 10 solution categories.

After estimating the topic model with LDA, each topic was coded for solutions found in Table 6.2.[115] Table 6.3 displays the top five words (right) for the topic terms estimated by the LDA model for each type of climate solutions (left-hand column).[116] (Full topic model results can be found in Table B.1 in Appendix B). As you can see, three solution types – cap-and-trade, conservation and efficiency, and renewables and alternatives – are associated with more than one set of topic terms. This is expected, and illustrates one of the advantages of LDA's flexibility, as these three solutions are the

[115] The codebook was created through a meta-analysis of the literature (see citations in Table X.X) and verified using a sample of Government Accountability Office (GAO) reports on climate change. These also informed the codebook developed for climate change news coverage. Several of the reports were prepared as witness testimony in hearings. The following reports were used: RCED-90-58, GAO/RCED-99-235R, GAO/RCED-00-166R, GAO-07-863, GAO-08-605, GAO-09-534T, GAO-11-317, GAO-11-876T, GAO-12-283, and GAO-13-242.

[116] As in the case of topic modeling news coverage in the prior chapter, I followed standard practices in the communications literature for reliability and validity (Nueundorf 2002), as well as those in the growing field of applied automated text analysis (Grimmer and Stewart 2012; Hopkins and King 2010; Quinn et al 2010; Bonilla and Grimmer 2013). I read the top 15 statements from each set of topic terms as determined by the proportion assigned by LDA estimates, which amounts to a 20% sample of the corpus. First, statements and topic terms were read and compared to ensure a vein of similarity ran through them, reflecting the topic terms derived from LDA. For all sets of topic terms, the average similarity score was approximately 87% and ranged from 66-100%. Second, a solution type was assigned to the topic terms. Third, a 10% random sample of the entire corpus of statements was re-coded by hand for solution type. The intra-reliability score for this exercise was approximately 90%.

most prevalent in climate policy debates. Cap-and-trade is the most oft-considered large-scale solution for reductions in carbon emissions, as it is a market-friendly approach successfully implemented in the past to control other greenhouse gases, such as sulfur dioxide (SO_2) and nitrogen oxides (NO_x) in acid rain measures.[117] The incremental solutions associated with conservation, efficiency, renewables, and energy alternatives were in place as responses to oil shortages in the 1970s before global warming and climate change became a fixture of the policy agenda in the late 1980s (Kammen 2010; Hawkins 2010). They are some of the most popular, cheap, effective and wide-ranging solutions next to a carbon tax or cap-and-trade (Kammen 2010).

Table 6.3. LDA Topic Terms for Climate Solutions

Solution Type	Topic Terms
Large-Scale Solutions	
Cap-and-Trade	emiss trade market carbon cap epa regul act air clean greenhous
Carbon Tax	cost tax will price consum
Incremental Solutions	
Conservation and Efficiency	energi effici util save conserv fuel emiss percent aviat industri energi build busi small green fuel vehicl standard car economi
Renewables and Alternatives	fuel ethanol use energi biofuel energi electr power generat renew
Carbon Sequestration	carbon coal technolog captur plant
Voluntary Reductions	emiss program greenhous voluntari
Carbon Offsets	agricultur carbon soil land offset
Mass Transit	transport transit need new invest
Technology R&D	technolog energi invest develop clean

Table 6.4 shows the distribution of climate solutions in hearing statements from 1987-2012. If one of the 11 solution types was one of the top three topic terms and

[117] https://www3.epa.gov/captrade/programs.html (accessed April 2016).

assigned an LDA proportion score of 0.10 or greater, it was coded for that solution type. This threshold is in line with climate studies that employ traditional human content-coding for the presence/absence of a certain category (see for example, Liu et al 2008, 2013, 2015; Park et al 2010). Hearing statements – both opening statements and witness testimonies combined – contained a total of 2,471 significant mentions of climate solutions from 1987-2012. Large-scale solutions account for 26% (640) of the total, with incremental solutions accounting for the remaining 74% (1,831).

Table 6.4: Distribution of Climate Solutions, 1987-2012

GHG Reduction Solutions	Count	Percentage
Large-Scale Solutions	**640**	**26%**
Cap-and-Trade	478	19%
Carbon Tax	162	7%
Incremental Solutions	**1831**	**74%**
Conservation and Efficiency	607	25%
Renewables and Alternatives	379	15%
Carbon Sequestration	282	11%
Voluntary Reductions	192	8%
Carbon Offsets	191	8%
Mass Transit	95	4%
Technology R&D	85	3%
	2471	

Cap-and-trade solutions make up the preponderance (75%) of policy debates on large-scale solutions to reducing greenhouse gases, and are 19% of the total number of climate solutions in hearing statements. In order of prominence, the incremental solutions are conservation and efficiency (25%); renewables and alternatives (15%); carbon sequestration (11%), voluntary reductions (8%); carbon offsets (8%); mass transit (4%); and tech R&D (3%). This lineup reflects the realities of climate policymaking in the US Congress – while large-scale policy solutions have been considered by both the House

and Senate, neither a carbon tax nor a cap-and-trade bill has been passed by both and sent to the White House. Incremental approaches to reducing greenhouse gas emissions, on the other hand, dominate policy debates about climate solutions – and legislative outcomes.

Table 6.5 provides excerpts from hearing statements for each of the large-scale and incremental climate solutions. The first is for cap-and-trade testimony given by Dallas Batraw, from Resources for the Future, a nonpartisan think tank, on the economic instruments (price collars and symmetric safety valves) in a cap-and-trade legislative proposal that sets a ceiling and a floor on the value of carbon credits traded on the market.[118] The carbon tax excerpt is from testimony given by Frank E. Loy, Undersecretary of Global Affairs at the State Department, on the success of the US delegation in excluding from Kyoto Protocol commitments to carbon taxes.[119] Under "conservation and efficiency" solutions, we have an opening statement made by Sen. John Chafee (R-RI) and testimony given by Rafe Pomerance of the World Resources Institute on conservation and efficiency provisions to reduce global warming that eventually became part of the Energy Policy Act of 1992.[120]

[118] Addressing Price Volatility in Climate Change Legislation, House, 111th Cong. 2009.
[119] Climate Change: Status of the Kyoto Protocol After Three Years, Senate, 106th Cong. 2000.
[120] Global Warming and Other Environmental Consequences of Energy Strategies, Senate, 102nd Cong. 1991.

Table 6.5: Examples of Climate Solutions in Hearings

Cap-and-Trade
The main point I want to communicate today is the opportunity for cost management through the introduction of a price collar or a symmetric safety valve around the price and allowance trading program. The price collar would set a price ceiling and a price floor for trading emission allowances.
Carbon Tax
We rejected both unrealistic and prohibitively expensive targets and mandatory policies and measures, such as carbon taxes ... we made it clear from day one that the Kyoto Protocol is not yet a finished product and that by itself it is not a complete solution to the problem of climate change.
Conservation and Efficiency
One thing I'd like to point out is that the Federal Government is one of the largest consumers of energy in the Nation, and I just think it behooves us to do everything we can to reduce the consumption of energy that the Federal Government uses and, as such, I have submitted legislation directing the General Services Administration to establish energy consumption targets for all buildings and thermal unit expenditures per square foot and then see if we can reduce it.
Much of the current energy policy controversy centers on the appropriate weight that should be assigned to energy production options versus conservation and efficiency programs. While this is an important discussion and high- lights the nature of the tradeoffs that characterize national energy policy, it does not get to the heart of the issue. A pollution pricing strategy for energy resources can provide the basis for national environment and economic benefits and supply the policy underpinning for strong conservation and renewable energy activities
Renewables and Alternatives
Renewable energy is going to be one of the key pillars of a clean energy economy. We are not going to be able to avoid catastrophic climate change without a dramatic increase in the amount of energy generated from renewable sources. Today only 2 1/2 percent of our electricity comes from all non-hydro renewables, but fortunately the United States has tremendous renewable energy resources that we have only just begun to tap.
New genetically altered organisms have been developed to produce fuels from plants and grains. Automobile manufacturers are selling cars and mini- vans capable of running on 85-percent ethanol.
Carbon Sequestration
[T]he existence of naturally-occurring CO_2 reservoirs proves that CO_2 can be sequestered for hundreds of thousands of years or more. Depleted oil and gas reservoirs are especially promising for long-term sequestration, because they have seals that have stood the test of time. They are also attractive because CO_2 sequestration can be combined with enhanced oil recovery, a mature technology that is applicable to 80 percent of oil reservoirs. The availability of a low-cost and abundant supply of CO_2 could be a boon to the domestic oil industry.
Voluntary Reductions
I am happy to talk about voluntary reporting of greenhouse gas emissions ... The Energy Policy Act of 1992 in section 1605(b) established this data collection which allows individuals or companies at their option to report annually on the reductions in the emissions of carbon dioxide, methane, or any of the other greenhouse gases.

Continue Table 6.5

Carbon Offsets
I have worked on land use and environmental policy for 20 years and offsets policy for the last 10 years. Offsets have received much attention, both positive and negative, as a policy option to address greenhouse gases and climate change. In the next 5 minutes I will review offsets, why they are proposed, opportunities they present for farmers, challenges and potential solutions to those challenges.
Mass Transit
[W]e burn 6,300 gallons of oil every second to fuel our transportation sector. So it is no wonder that we have to look at a more responsible transportation policy. That sector is responsible for one quarter of the greenhouse gas emissions, according to the EPA study for 2005.
Technology R&D
Geoengineering describes two distinct concepts. Carbon dioxide removal, CDR, is a set of tools for removing carbon dioxide from the atmosphere, while solar radiation management, SRM, would reduce the earth's absorption of solar energy, cooling the planet by adding sulfur aerosols to the upper atmosphere or by adding sea salt aerosols to whiten marine clouds.

Turning to the "renewables and alternatives" climate solutions on Table XX, the first excerpt is from an opening statement given by Rep. Henry Waxman, who stated that "[r]enewable energy is going to be one of the key pillars of a clean energy economy" at a hearing to examine its role in reducing greenhouse gases.[121] The second except is from an opening statement made by Sen. Richard Lugar (R-IN), Chairman of the Committee on Agriculture, Nutrition, and Forestry, about using ethanol from corn to reduce greenhouse gases to allay the agricultural sector's fears that they would come out on the losing side in Kyoto negotiations.[122] On the topic of carbon sequestration, Dr. Sally Benson from the Lawrence Berkeley National Laboratory provided testimony to explain this carbon capture technology, which was a feature of a W. Bush Administration initiative to address climate change.[123] Jay Hakes from the Energy Information Administration (EIA) testified about their program to provide regulatory credits for any future carbon capping programs as an incentive to companies who voluntarily reduce

[121] Renewable Energy: Complementary Policies for Climate Legislation, House, 111th Cong. 2009.
[122] Many Ways Renewable Fuels Could Aid in Decreasing Greenhouse Gas Emissions and Increasing Energy Security, 105th Cong. 1997.
[123] What Are the Administration Priorities for Climate Change Technology?, House, 108th Cong. 2003.

their greenhouse gases.[124] On carbon offsets, Brian Murray from the Nicholas Institute for Environmental Policy Solutions at Duke provided testimony about offsetting greenhouse gas emissions via agriculture and forest management.[125] Finally, the excerpt from the technology R&D category comes from testimony given by David Keith, Research Chair on Energy and the Environment at the University of Calgary, on cloud whitening, a geoengineering technology, which is injecting aerosols into marine clouds to reflect solar radiation and reduce global warming.[126]

Figure 6.1 shows the number of large-scale (top) and incremental (bottom) solutions in policy debates on climate change from 1987 to 2012. In total, there are 308 hearings that contained significant mentions of either type of climate solution. By type, there are 154 hearings that contain significant mentions of large-scale solutions, averaging 1.4 per hearing, with a standard deviation of 3.0 and a range of 0-17. The House accounts for 57% of debate on large-scale solutions; and, Republican-majority chambers contain just 22%. There are 280 hearings that contain significant mentions of incremental solutions, averaging 4.1 per hearing, with a standard deviation of 5.1 and a range of 0-23. The House accounts for 52% of debate on incremental solutions; and, Republican majorities contain 24%.

Comparing the two figures, incremental solutions are a staple of climate policy debates, whereas large-scale solutions are mentioned much more intermittently for most of the series. We can see small clusters of large-scale solutions (top) between 1988 and 1989, 1991 and 1992, late 1997 and 1998, large spikes in 2001, 2005 and 2011, and a cluster of a high number of significant mentions from 2007 to early 2010. In 1988 and

[124] Credit for Early Action: Win-Win or Kyoto Through the Front Door, House, 106th Cong. 1999.
[125] Hearing to Review the Costs and Benefits of Agriculture Offsets, House, 111th Cong. 2009.
[126] Geoengineering: Parts I, II, and III, House, 111th Cong. 2010.

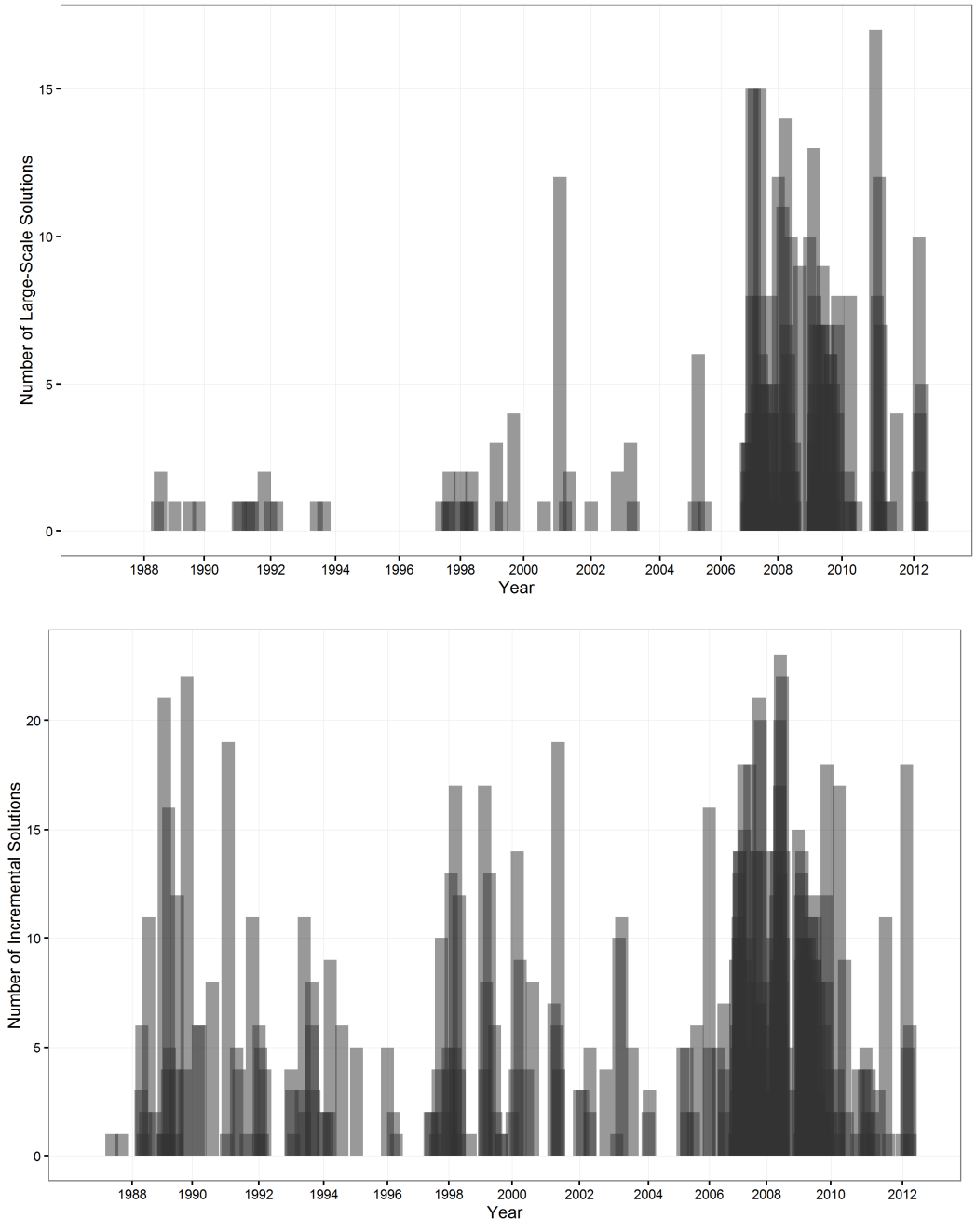

Figure 6.1: Number of Large-Scale and Incremental Solutions in Policy Debates on Climate Change, 1987-2012

1989 Congress was debating provisions for what would become the Clean Air Act amendments of 1990. This established the Acid Rain Program, which put in place a cap-and-trade solution to reduce the greenhouse gases SO_2 and NO_x.[127] Policy debates leading up to this act also included consideration of carbon dioxide into this particular program.[128] The cluster in 1991 and early 1992 is on account of policy debates about capping emissions leading up to and following the Rio Summit (*CQ Almanac 1992* 1993). Another climate summit and the international treaty that came out of it – the Kyoto Protocol – explains the slight increase in policy debates regarding large-scales solutions in 1997 and 1998 (*CQ Almanac 1997* 1998a,b).

In 2001, there is a substantial increase in large-scale solutions. In the background of W. Bush reversing his support of the Kyoto Protocol ahead of a climate summit (Adams 2001a), the newly-Democratic Senate debated extending the acid rain cap-and-trade program to carbon emissions in Clean Air Act amendments oversight hearings. This debate was the nascent beginnings of what would become the McCain-Lieberman cap-and-trade proposal, the Climate Stewardship Act of 2003.[129] The 2005 increase coincides with W. Bush's Clean Air Rule, which put new caps on SO_2, NO_x, ozone and soot.[130] In Congress, the cap-and-trade Climate Stewardship Act was reintroduced and defeated as an amendment to legislation that became the Energy Policy Act of 2005 (*CQ Almanac 2005* 2006). The cluster in 2007 to early 2010 reflects debates in the newly-Democratic majority House and Senate on a carbon tax and several cap-and-trade proposals (Palmer

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[127] https://www3.epa.gov/captrade/programs.html (Accessed April 2016).
[128] Global Environmental Protection Act of 1988, Senate, 100th C., 1988.
[129] Clean Air Act Oversight Issues, Senate, 107th C., 1997. In June of 2001, Senate party control switched as a result of Jim Jeffords' decision to caucus with the Democrats. He was Chairman of the Committee on Environment and Public Works. This committee renamed one of its subcommittees to Clean Air, Wetlands, and Climate Change, with Joe Lieberman as Chair.
[130] https://georgewbush-whitehouse.archives.gov/ceq/clean-air.html. (Accessed April 2016).

2007). In 2009, the House passed Congress' first cap-and-trade legislation to reduce carbon dioxide emissions, the American Clean Energy and Security Act (HR 2454) (*CQ Almanac 2009* 2010). Senate negotiations led by John Kerry, Joe Lieberman, and Lindsay Graham, could not muster a compromise and legislation died in committee following a Republican boycott of a markup session (*CQ Almanac 2010* 2011). Finally, we see an expansion of large-scale climate solutions in policy debates in 2011. This is a result of legislation passed by the newly Republican-majority House to ban the EPA from regulating any and all greenhouse gases, following the EPA's proposed rules for limiting carbon dioxide emissions in 2010 (*CQ Almanac 2011* 2012).

Turning to incremental solutions in Figure 6.1 (bottom graph), we can see reflected in this figure that they are a fixture of policy debates on climate solutions (Schneider et al 2010; Dryzek, Norgaard, and Schlosberg 2011). The highpoints are in years 1989, 1991, 2001, 2007, and 2008. In 1989 and 1991, Congress held several hearings to examine conservation and efficiency, renewables and alternative energy options to address the "greenhouse effect."[131] These policy debates were precursors to provisions in the Energy Policy Act of 1992. In 2001, Congress considered several incremental options to reduce global warming, including alternative fuels, conservation, and fuel efficiency standards.[132] These were part of policy debates that led up to passage of the Energy Policy Act of 2005. In 2007, biofuels and other incremental solutions such as renewables and efficiency were provided as "differing views" in light of cap-and-trade proposals.[133] In 2008, policy debates in congressional hearings heightened in discussing

[131] National Energy Policy Act of 1989 (PURPA), Part 2, Senate, 101st Cong., 1989; National Energy Policy Act of 1989 (Energy Efficiency and Renewable Energy), Part 1, Senate, 101st Cong., 1989; Global Warming and Other Environmental Consequences of Energy Strategies, Senate, 102nd Cong., 1991.
[132] Climate Change Technology and Policy Options, Senate, 107th Cong., 2001.
[133] The Gas is Greener: The Future of Biofuels, House, 110th Cong., 2007; America's Climate Security Act of 2007, S 2191, Senate, 110th Cong, 2007.

conservation and fuel efficiency to reduce emissions from the transportation sector[134] and energy efficiency in buildings.[135] Incremental solutions were also considered as complementing and as alternatives to several cap-and-trade proposals in the House in 2008.[136] Heightened activity in 2008 is also a result of provisions in the American Recovery and Reinvestment Act of 2009 – the Stimulus package – which included several clean energy incremental solutions (Aldy 2011).

Data: Collecting and Content Coding New Coverage

This chapter examines how three independent variables derived from news coverage – attribute diversity, causal uncertainty and volume – shapes policy debates on climate solutions. Data on news coverage is the same as that used in the previous chapter on problem prioritization. The full-text of 4,765 newspaper articles for 1987-2012 from the *New York Times* and the *Washington Post* were collected from a *LexisNexis*[137] keyword search limited to the headline and leading paragraph using the terms "greenhouse gases", "greenhouse effect", "climate change", and "global warming."[138] Irrelevant articles – those only mentioning climate change in passing – and duplicates were removed. These two news organizations – the *Times* and the *Post* – are widely used in the policy agendas literature and media studies of climate change (Boydstun 2013; Jones and Baumgartner 2005; Baumgartner and Jones 1992; Liu et al 2011, 2013).

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[134] Climate Change Impacts on the Transportation Sector, Senate, 110th Cong., 2008.
[135] Climate Benefits of Improved Building Energy Efficiency, House, 110th Cong., 2008.
[136] Legislative Proposals to Reduce Greenhouse Gas Emissions: An Overview, House, 110th Cong., 2008.
[137] http://www.lexisnexis.com/hottopics/lnacademic/
[138] This standard set of terms is used in media studies and congressional studies of climate change. See for example Boykoff and Boykoff (2004, 2007), Liu et al (2008; 2011; 2013; 2015), Park et al (2010).

Volume of News Coverage

Volume of news coverage is the amount of attention the media devotes to climate change. As a media signal to policy communities, it moderates the salience and importance attached to the climate problem – which mobilizes attention to understanding and solving it. This indicator has a long history in being linked to agenda dynamics and policy change (Baumgartner and Jones 1993; Jones and Baumgartner 2005; Boydstun 2013; McCombs 2008; for a review see Van Aelst and Walgrave 2006). Though to be sure, less is known about how it structures the dynamics of solution generation in policy debates. As a measure, volume is calculated as the number of newspaper articles per unit of time. At the monthly level, the volume of climate coverage averages 15.4, with a standard deviation of 17.8 and a range of 0-114 articles per month.

Figure 6.2 shows the volume of news coverage from 1987-2012 aggregated to the quarterly level. As a reminder, Chapter X discusses the volume of climate coverage in detail. There are notable increase in the volume of coverage in 1988, 1992, 1997, and 2000-2001. Starting in late 2004, volume steadily increases until it surges in 2007 and again in late 2009 through early 2010. These increases are triggered by events – most notably climate summits and releases of IPCC reports – and elite conflict over climate policy and scientific controversies. These peaks are consistent with other media studies of climate change in the news over time (see Ungar 1992, 1995; McComas and Shanahan 1999; Boykoff and Boykoff 2004, 2007; Liu et al 2008; 2013).

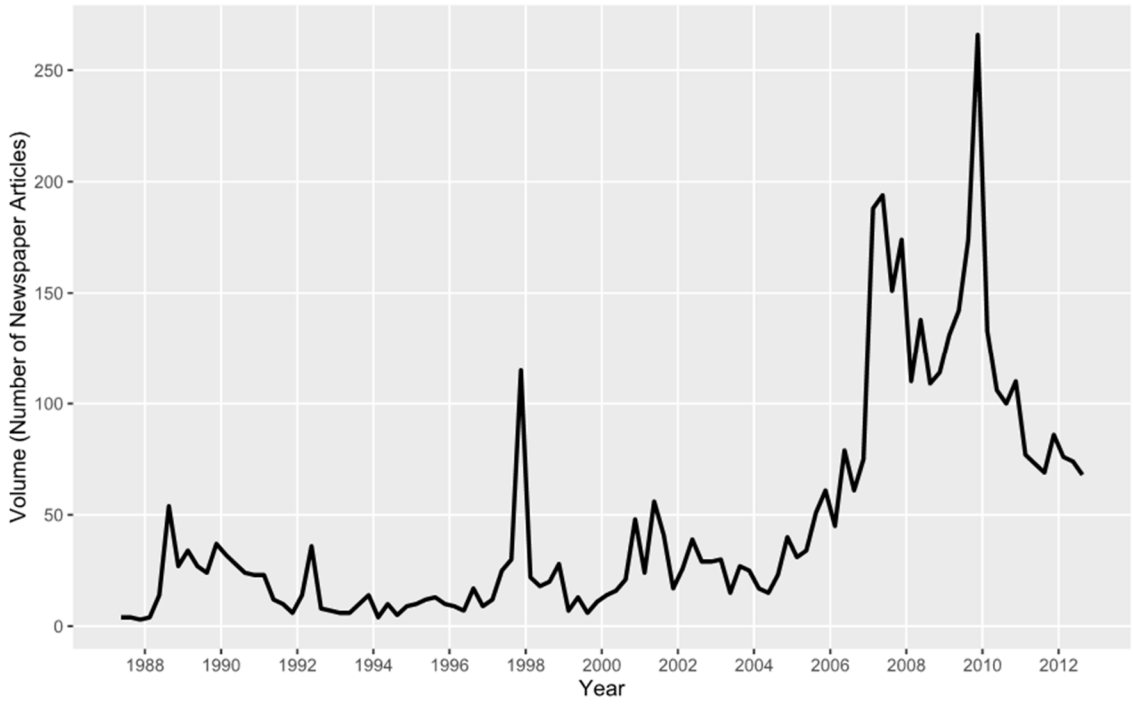

Figure 6.2: The Volume of Climate Change News Coverage, 1987-2012

Content Coding Climate News for Attribute Diversity and Causal Uncertainty

The full-text of the 4,765 newspaper articles were coded for policy content using the two-step machine-human hybrid LDA topic modeling approach to measure attribute diversity and causal uncertainty.[139] The results from the topic model were coded for substantive climate change policy content[140] using a codebook that was based on a meta-

[139] [139] Robustness is defined as the stability and validity of topic terms for small changes in the number of topics estimated (Blei 2012; Grimmer and Stewart 2012; Grimmer and King 2010). I settled on a model that estimated 75 sets of topic terms for climate coverage attributes. After removing "junk" categories, and topics that identified locales, political actors, and entertainment without policy content, 49 topic terms remained).

[140] For code reliability and validity, I followed standard practices in communications (Nuendorf 2002) and recommendations from the applied topic modeling literature (Grimmer and Steward 2012; Hopkins and King 2010; Quin et al 2010; Bonilla and Grimmer 2013). The top 15 articles from each set of topic terms assigned by LDA were read to ensure that there was a vein of similarity that flowed through the articles that matched the set of topic terms derived from the estimates. This amounts to a 20% sample. For all cases, the similiarity score averaged 90%, with a range of 73-100%. A topic attribute from the codebook was then assigned to the set of topic terms. A 10% random sample of the entire newspaper corpus was recoded, resulting in an intra-coder reliability score of approximately 85%.

analysis of the literature on climate change news coverage[141] and converted into a modified version of the Policy Agendas Project codebook[142] specifically for climate change attributes. The codebook can be found in Table A.1 in Appendix A. As a reminder from the detailed discussion of climate change attributes in the second section of Chapter 4, there are 32 unique attributes in climate new coverage nestled under nine distinct umbrella categories: climate science, economics, energy, environment, international, extreme weather, national security, public health, and technology R&D. Table 6.6 shows these categories and provides examples of the attributes that fall within them.[143]

Table 6.6: Attributes in News Coverage by Major Climate Category

Category	Description of Attributes
Climate Science	Carbon dioxide and global warming, climate science scandals, computer modeling and simulation, sea-level rises, human contribution, natural variation, scientific reports, temperature trends
Economics	Competitiveness of US industries, costs/benefits, employment (e.g., "green jobs"), climate program costs
Energy	Alternatives and renewables, coal, conservation and efficiency, gas and oil, nuclear power
Environment	Coastal erosion, endangered species, greenhouse gas emissions and pollution, water conservation
International	Climate summits, European Union, international treaties, newly industrialized countries (China, India, and Brazil)
Extreme Weather	Drought conditions, heat/cold waves, hurricanes
Other	National security, public health, technology R&D

[141] Ungar (1992, 1995); McComas and Shanahan (1999); Boykoff and Boykoff (2004, 2007); Liu et al (2008, 2013); Antilla (2005); Trumbo (1996); Zehr (2000; 2009); Mazur and Lee (1993).
[142] http://www.policyagendas.org/page/datasets-codebooks#codebook
[143] National security, public health, and technology R&D are considered umbrella categories but are presented as "Other" for display purposed only.

Table 6.7 provides examples of the LDA topic terms (right) that were assigned to the unique climate attributes (middle) for each dimension/category of climate change (left). Table A.2 in Appendix A shows all topic terms and code for climate news coverage.

Table 6.7: Topic Terms and Attributes for Climate News

Dimension	Topic (Attribute) Name	Topic Terms
Climate Science	Temperature trends	warm temperatur model degre global
	Sea-level rise	ice arctic sea melt glacier
	Science scandals	climat scienc scientist research scientif
	Carbon dioxide/global warming	atmospher carbon effect dioxid earth
	Human contribution	year human ago planet age
Economics	Employment ("green jobs")	work technolog like one new
	Climate program costs	program million plan fund project
Energy	Oil and gas	oil gas energi drill natur
	Alternative fuels	ethanol crop use product corn
	Renewable energy	energi electr power percent wind
Environment	Endangered species	speci bear said fish anim
	Coastal erosion	sea rise level water island
	Greenhouse gas pollution	carbon dioxid emiss greenhous gas
International	International treaties	kyoto treati countri emiss unit
	Industrializing nations	countri china unit world india
	Developing countries	countri world develop africa nation
Extreme Weather	Natural disasters	chang climat weather hurrican drought
	Cold waves	like winter one snow peopl
Other	National Security	secur war militari unit nation
	Public Health	health diseas peopl problem death
	Technology R&D	energi fuel technolog coal effici

Calculating Attribute Diversity

Attribute diversity in news coverage moderates problem uncertainty in policy communities operating in the muddled space that characterizes climate change. Attribute diversity captures the ambiguity in the concentration and variety of climate attributes in

the news. Strong media signals of attribute diversity should amplify problem uncertainty in policy communities, thereby encouraging policy debates of incremental rather than large-scale solutions. The proportions assigned to newspaper articles that were estimated by the LDA topic model and policy content coded for climate change attributes were used to calculate *entropy*,[144] a measure of diversity used across multiple fields, including ecology, communications, sociology, information theory, and the policy process (McDonald and Dimmick 2003; Boydstun et al 2014). Boydstun (2013) used entropy to measure the "diversity of discussion" in news coverage of threats of terrorist attacks and the death penalty. It has been used elsewhere in studies of jurisdictional competition among congressional committees (Baumgartner et al 2000; Sheingate 2006), volatility in policy agendas (Talbert and Potoski 2002), competition and diversity in newspapers (Chaffee and Wilson 1977; Lasorsa 1991), and complexity in the policy information environment (Wolfe 2010).

Entropy is a great measure of attribute diversity because it captures the number (variety) of attributes in climate coverage as well as their relative distribution (concentration). Entropy increases as the distribution of coverage becomes more evenly spread among attributes; and decreases for the opposite reason. For the theory of media signaling this means that higher entropy means stronger signals that should in turn amplify problem uncertainty in policy communities engaged in climate policy debates. The average entropy score for the monthly series is 1.26, with a standard deviation of 0.35 and a range of 0.36-1.76.

[144] **Shannon's H Entropy**: $-\sum_{i=1}^{n}(p(x_i)) * \ln p(x_i)$, where x_i represents an attribute, $p(x_i)$ the proportion of news coverage devoted to that attribute, and $\ln p(x_i)$ the natural log of that proportion. The entropy score is calculated as the inverse sum of a proportion times its log, over all *n* attributes.

Figure 6.3 is a time series of attribute diversity in climate coverage from 1987 through 2012. It trends upwards over time, with a large degree of variation in the beginning of the climate news coverage. The variation and trend level off starting around 2005, where it varies more subtly around new highs. We can infer that media signals of attribute diversity were strong during this period – and stayed strong. This precedes the expansion of policy debates on climate solutions we saw in the time series of large-scale and incremental solutions. The variation in the beginning and middle of the series tracks with the expansion and contraction of incremental solutions in policy debates shown in the previous figure as well.

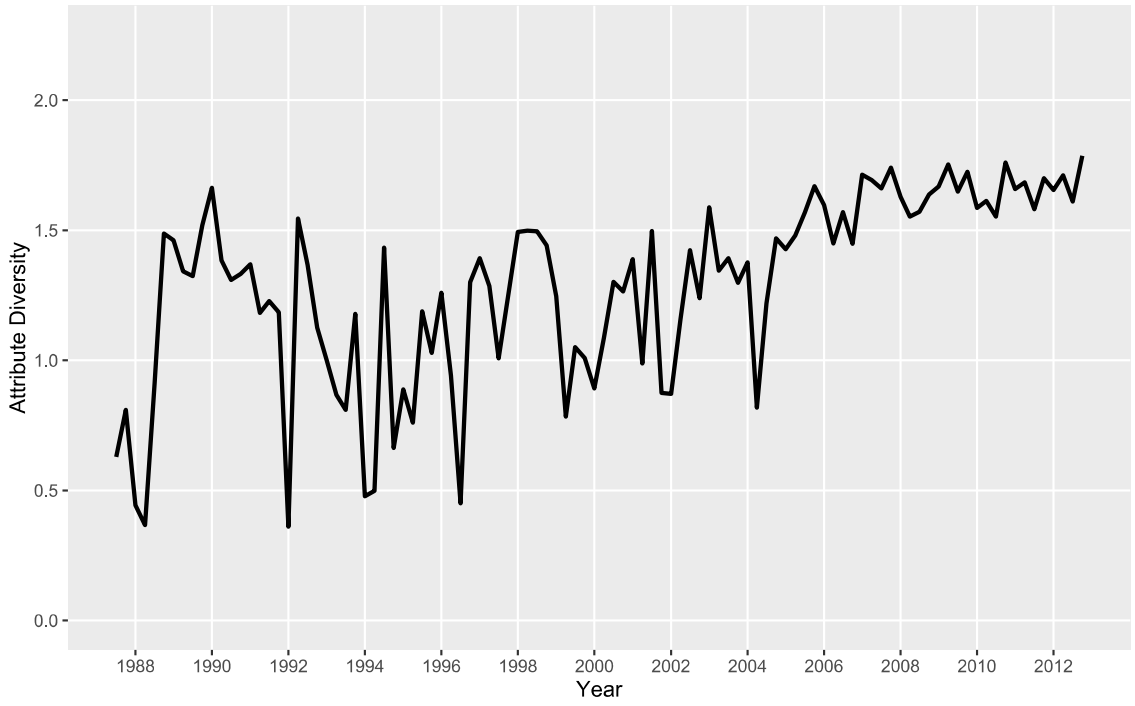

Figure 6.3: Attribute Diversity in Climate News Coverage, 1987-2012

Calculating Causal Uncertainty

Causal uncertainty in news coverage is reporting on the uncertainty in causal relationships that link human behavior with global warming, global warming with climate change, and climate change with its myriad impacts, such as sea-level rise. Climate science as a dimension of news coverage is used to measure causal uncertainty.[145] Recall Figure 4.4 in Chapter 4 that explains how news coverage of climate science converges around three forms of uncertainty: (1) human contribution; (2) temperature trends; and (3) impacts (Painter and Ashe 2012; Schmid-Petri et al 2015). These categories were actually based on collaborative work between media scholars and climate scientists (see Rahmstorf 2004). The pathways to uncertainty via reporting on the causal connections in climate science studies is both real, reflecting scientific language and internal debates, and manufactured, reflecting political motivations to cast doubt on the climate problem. Rep. Lamar Smith's (R-TX) op-ed in the *Washington Post* is a good example of causal uncertainty in climate news coverage:

> Contrary to the claims of those who want to strictly regulate carbon dioxide emissions and increase the cost of energy for all Americans, there is a great amount of uncertainty associated with climate science. These uncertainties undermine our ability to accurately determine how carbon dioxide has affected the climate in the past. They also limit our understanding of how anthropogenic emissions will affect future warming trends. Further confusing the policy debate, the models that scientists have come to rely on to make climate predictions have greatly overestimated warming.[146]

---

[145] This was verified by coding the full-text of all climate science articles – as derived from the topic models and hand-coded for policy content – with three well-known sentiment dictionaries that are used to measure uncertainty in texts. The correlations ranged from 0.82-0.97 with the dictionary result from Loughran and McDonald (2011), Lexicoder (Young and Soroka 2011) and the WordStat Sentiment Dictionary (2013). In addition, I created my own dictionary using the literature on uncertainty in climate news coverage (Boykoff and Boykoff 2004, 2007; Antilla 2005; Zehr 2000; and Painter and Ashe 2012); the correlation coefficient with 'climate science' articles was 0.91.

[146] May 19, 2013. https://www.washingtonpost.com/opinions/lamar-smith-overheated-rhetoric-on-climate-change-hurts-the-economy/2013/05/19/32cb6d94-bda4-11e2-97d4-a479289a31f9_story.html. (Accessed April 2016).

Causal uncertainty in news coverage is a media signal that can intensify disputes over problem severity in the policy community. Clarity in what scholars of the policy process call causal stories (Stone 1988, 1989) – connecting a human activity with unwanted outcomes that should be prevented or alleviated by government intervention – has been shown to be a crucial determinant leading to large changes in environmental policy (Baumgartner and Jones 1993; Scheberle 2005).

Table 6.8 shows the attributes under the "climate science" dimension that were used to measure causal uncertainty in news coverage. As you can see, these map onto diagram and to the three types of uncertainty found in the aforementioned literature. They are carbon dioxide and global warming; climate science scandals; computer modeling and predictions; sea-level rises; human contribution; natural variation; scientific reports; and temperature trends.

Table 6.8: Attributes of Climate Science that Create Causal Uncertainty

Dimension	Attributes
Climate Science	Carbon dioxide and global warming, climate science scandals, computer modeling and simulation, sea-level rises, human contribution, natural variation, scientific reports, temperature trends

Causal uncertainty is calculated as the proportion of news coverage devoted to the climate science dimension per month. The final proportion score came about by dividing the number of significant climate science mentions by the sum of all mentions of dimensions for that month. As with the dependent variables for climate solutions as calculated with policy debates, a significant mention is considered to be true if at least one of a newspaper article's top three attributes is assigned 0.10 or higher by the LDA topic modeling estimates. There were 2105 total mentions of 'climate science' in news coverage, with an average and standard deviation of 6.8 and a range of 0-49 mentions in a

month. The average proportion (as a percentage here for convenience) is 28% a month, with a standard deviation of 21% and a range of 0-100%.

Figure 6.4 shows the proportion of causal uncertainty in climate news coverage from 1987 through 2012. We can see that causal uncertainty varies quite a good deal until around 2007, and then surges notably again in 2009 and early 2010. It was during this time that two science scandals dominated the news cycle on climate change – errors in an IPCC report and Climategate. Anecdotally, this is also when cap-and-trade legislation died in the Senate.

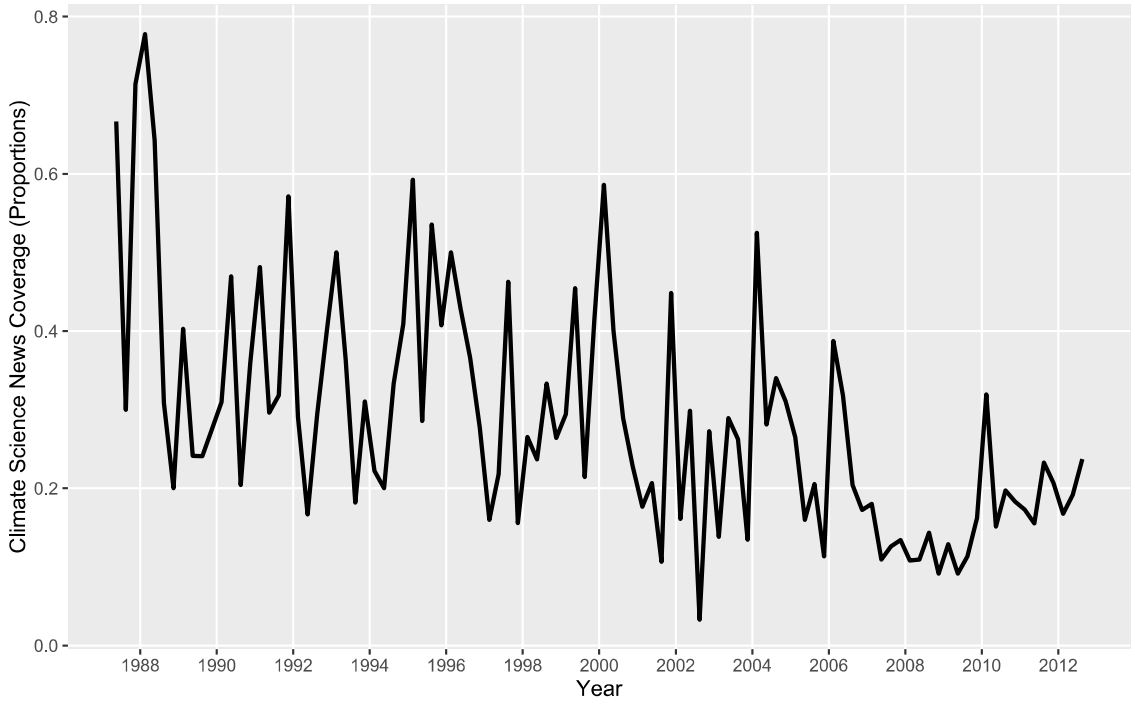

Figure 6.4: Causal Uncertainty in Climate News, 1987-2012

Control Variables

In addition to attribute diversity, causal uncertainty and volume – the three media variables of interest – data on several other variables was collected to control for

objective conditions, events, party, chamber, divided government, public opinion, and the economy. For objective condition, the Climate Extremes Index (CEI) (Karl et al 1996; see Liu et al 2011) accounts for US temperature trends, precipitation, and tropical storms (hurricanes and cyclones) in one single indicator.[147] Instances of climate summits and IPCC reports control for policy debates on solutions driven by events (Liu et al 2011).[148] Republican majority,[149] chamber,[150] and divided government[151] are used as political and institutional controls. Stimon's Public Mood measure accounts for the influence of public opinion.[152] The gross domestic product (GDP) is used to control for the effects of a changing economy. Finally, the sum of opening statements and witness testimonies per hearing is a control variable in both models since solution data was generated from these texts.[153]

Findings: Limiting Climate Solutions

Large-scale and incremental solutions to the climate problem are used as dependent variables to examine how news coverage – attribute diversity, causal uncertainty and volume – paralyzes consideration of punctuated changes, steering debate instead toward smaller-scale policy change. This section discusses results for large-scale solutions first and incremental solutions second. Negative binomial regression is used to model the relationship between solutions and news coverage, and to investigate disproportionate information-processing and party influence. Because the dependent

[147] Data collected from NOAA www.nrdc.gov. For a detailed definition of the CEI, see https://www.ncdc.noaa.gov/extremes/cei/definition. The CEI series for 1987-2012 averages 24.5, with a standard deviation of 7.7 and a range of 14.3-49.4.
[148] 12 events in total, expanding on Liu et al's (2011) list, coincide with 19% of congressional hearings.
[149] Republican majority chambers account for 27% of all hearings.
[150] House hearings account for 54% of all hearings.
[151] Divided government was present in 61% of all hearings.
[152] Public mood averaged 60.3, with a standard deviation of 3.0 and a range of 48.9-65.39.
[153] Total statements and testimonies averaged 10 per hearing, with a standard deviation of 6 and a range of 1-36.

variables are event counts – the number of large-scale solutions mentioned in policy debates for the first model – they are not continuous, so negative binomial regression was used. This approach produces more accurate and efficient estimates than linear regression (King 1989) and to account for overdispersion found in most social processes (Cameron and Trevedi 1986; Long 1997). The simpler event count Poisson does not control for overdispersion. If Poisson is used despite overdispersion, this could bias estimates of standard errors downwards, leading to over-precision confidence of the coefficients (Cameron and Trevedi 1986).

The first model presented gauges to what degree news coverage plays a prohibitive role regarding policy debates of large-scale climate solutions, such as cap-and-trade or a carbon tax. The theory of media signaling presented in this dissertation expects the following:

> 3: Large-scale solutions in policy debates will decrease with attribute diversity and causal uncertainty in climate news coverage because these media signals amplify problem uncertainty and highlight disputes over the seriousness of the problem, respectively. This reduces the political feasibility of comprehensive approaches to fixing the climate problem.
>
> 3a: Large-scale solutions will increase with the volume of coverage because it signals growing importance of the climate problem, which encourages policy debates on fixing it.
>
> 5: Threshhold effects for climate news signals will vary by coverage type and stage in the problem definition process.
>
> 6: Republicans should be less active in the problem definition process save for giving opening statements at hearings to highlight its uncertainties and/or steer debate towards "nonproblemicity."

Figure 6.5 shows findings for the first negative binomial model, which estimates the number of large-scale solutions in policy debates as a function of attribute diversity,

high levels of causal uncertainty,[154] volume, climate extremes (CEI), international conferences, Republican majority, U.S. House, public mood, GDP, time, and the sum of statements and testimonies.[155] The unit of analysis is a congressional hearing. The date of the first session of each hearing was used to create six-month lags for the three independent variables on climate news coverage – attribute diversity, causal uncertainty, and volume. (Full regression results are in Table A.2 in Appendix A). The points on the figure represent coefficient estimates and the horizontal bands are 95% confidence intervals. Points that fall to the left of the solid vertical line at the zero tick mark represent negative coefficients and those to the right are positive. Confidence bands that do not intersect zero are considered statistically significant.

[154] Threshold effects. High levels of causal uncertainty is a dichotomous variable where 1 is assigned if the value at time *t* is greater than the average of *t-1* and *t-2*; and 0 if below. This accounts for 41% of all cases.
[155] Three observations were dropped because they were outliers.

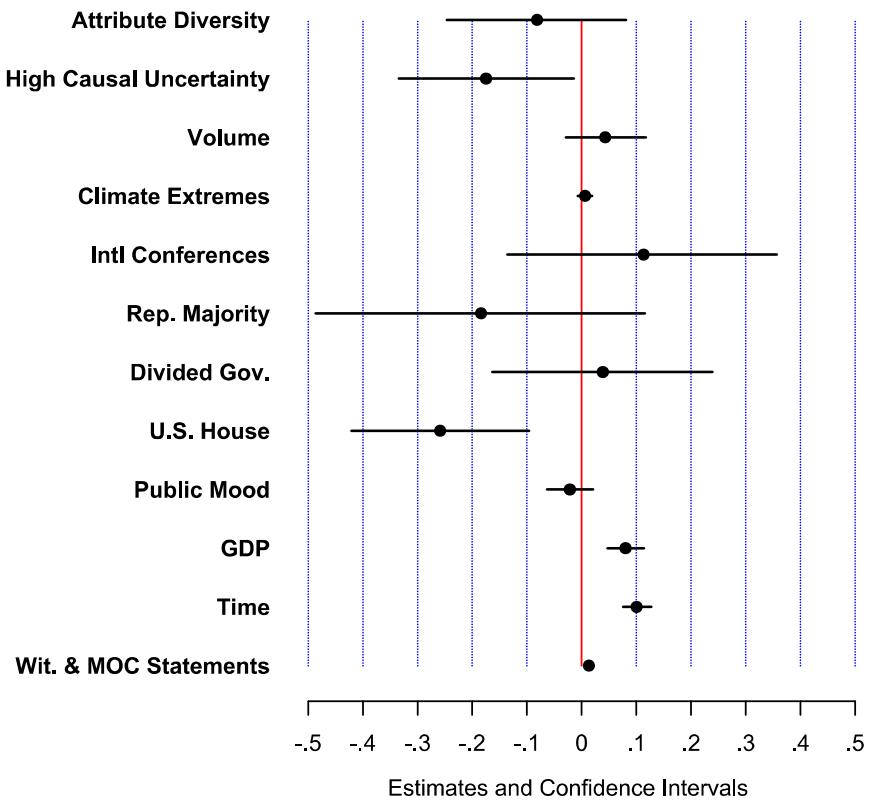

Figure 6.5: Negative Binomial Model: The Number of Large-Scale Climate Solutions, 1987-2012

The overall results provide limited support for expectations on the influence of news coverage on the number of large-scale climate solutions in congressional policy debates. The coefficient for high causal uncertainty is negative and significant at the 0.05 level. This implies that large-scale climate solutions are curtailed in policy debates when there are strong signals about causal uncertainty from news coverage. This also demonstrates support for the expectation that there are threshold effects for media signals because political institutions are disproportionate information processors. The coefficient for attribute diversity is in the expected direction – it too should dampen policy debates about large-scale solutions. However, the coefficient estimates are not statistically

significant. The estimates for volume are also in the expected direction – large-scale solutions should increase as media signals the importance of the climate problem. However it is also the case here that the coefficient fails to reach statistical significance.

The coefficient for Republican majority is in the expected directions, but does not reach statistical significance either. There is a negative and statistically significant relationship between the House and large-scale policy solutions. At first this may seem counterintuitive because it was only this chamber, and not the Senate, that was able to pass cap-and-trade legislation. But the Senate was the forum of prolonged cap-and-trade debates that surpassed the House it terms of duration and degree of contention (Davenport 2010). The following are the remaining control variables that failed to reach statistical significance: climate extremes, international conferences, divided government and public mood.

Changes in the economy as measured by GDP, time, and the variable that controls for total number of statements and testimonies – they are all positive and statistically significant. Large-scale solutions in policy debates increase as the economy improves, which on its face makes sense since cap-and-trade and carbon tax proposals involve consideration of substantial shifts in the allocation of resources. And, large-scale solutions increase over time, which is expected in the evolution of the climate problem – more time to understand it and rally support around comprehensive approaches to fixing it.

We know turn to a discussion of how causal uncertainty in news coverage shapes large-scale solutions in climate debates. It is difficult to interpret the effects of coefficients and their statistical significance directly from the output of a negative binomial regression. Since this is the case, Figure 6.6 shows predicted counts of large-scale solutions for when causal uncertainty in the news coverage is below average (left)

and when it is above average (right). The points represent the number of large-scale solutions and the vertical lines the 95% confidence bands. Keep in mind that the average number of large-scale solutions for the series is 1.4. The predicted number of large-scale solutions decreases by 15% when causal uncertainty moves from below to above average levels in news coverage. This supports the notion that strong media signals of causal uncertainty can "break through the noise" of policy debates taking place in the muddled space that defines climate change, which heightens disputes over problem severity and moves policy communities away from comprehensive approaches to tacking the problem.

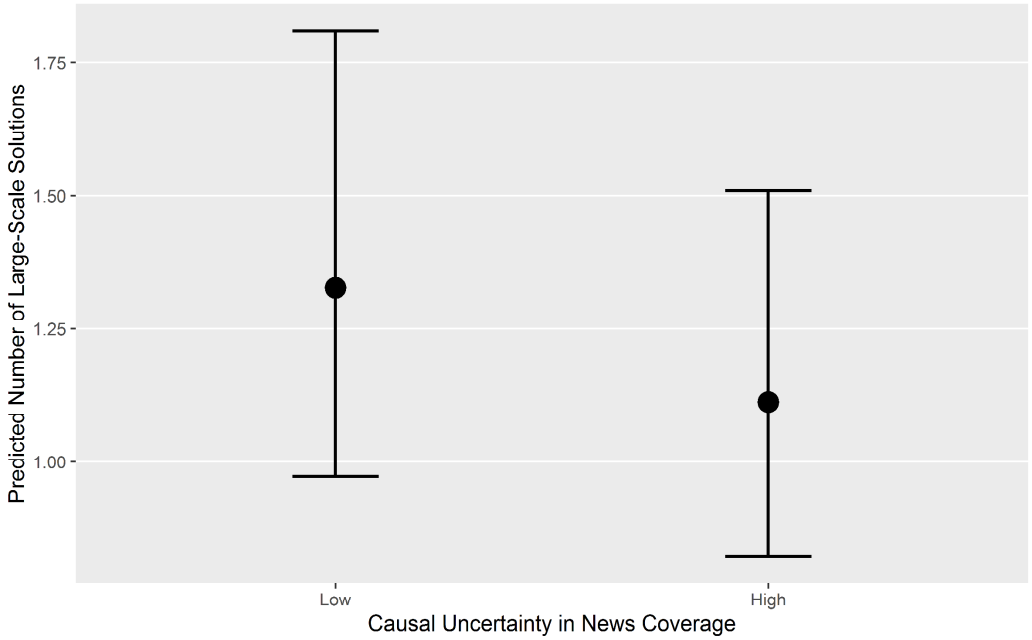

Figure 6.6: Predicted Number of Large-Scale Solutions for Causal Uncertainty in News Coverage

The complement of this dynamic is that aspects of news coverage can move debates about policy solutions away from large-scale changes and towards incremental approaches to solving the climate problem. The second model investigates this by estimating the number of incremental solutions in policy debates as a function of attribute diversity, high levels of causal uncertainty, volume, climate extremes, international conferences, Republican majority, divided government, U.S. House, public mood, GDP, time, and the total number of statements and testimonies made at each hearing. As with the case of large-scale solutions, the date of the first session of each hearing is used to create a six month lag for the three media variables – attribute diversity, causal uncertainty and volume. Negative binomial regression is also employed as the more appropriate alternative to normal linear regression and to account for overdispersion. (Full regression results can be found in Table A.3 in Appendix A).

Along with the expectations for threshold dynamics due to disproportionate information-processing in the model for large-scale solutions (#5), the theory of media signaling suggests the below expectations in regards to incremental solutions in climate policy debates:

> 4: Incremental solutions will increase with attribute diversity and causal uncertainty in climate coverage because media signals that amplify problem uncertainty and disputes over severity will increase the political feasibility and policy tool appropriateness of smaller-scale solutions.
>
> 4a: Incremental solutions will decrease with volume of news coverage because the signal of importance will shift debates to considering solutions far greater in scope and potential effectiveness.
>
> 6a: Republican majorities will be associated with increases in incremental climate solutions because they are less-costly alternatives and provide the opportunity to attach existing solutions to new problems.

Figure 6.7 shows the results for the incremental solutions model. As a reminder, the points represent coefficients and the bands their 95% confidence intervals. Points to the left of the vertical line placed at the zero mark represent negative point estimates and those to the right – positive. Confidence bands that do not intersect the zero mark are considered statistically significant. All three media variables are statistically significant and are in the direction that corresponds with the above expectations.

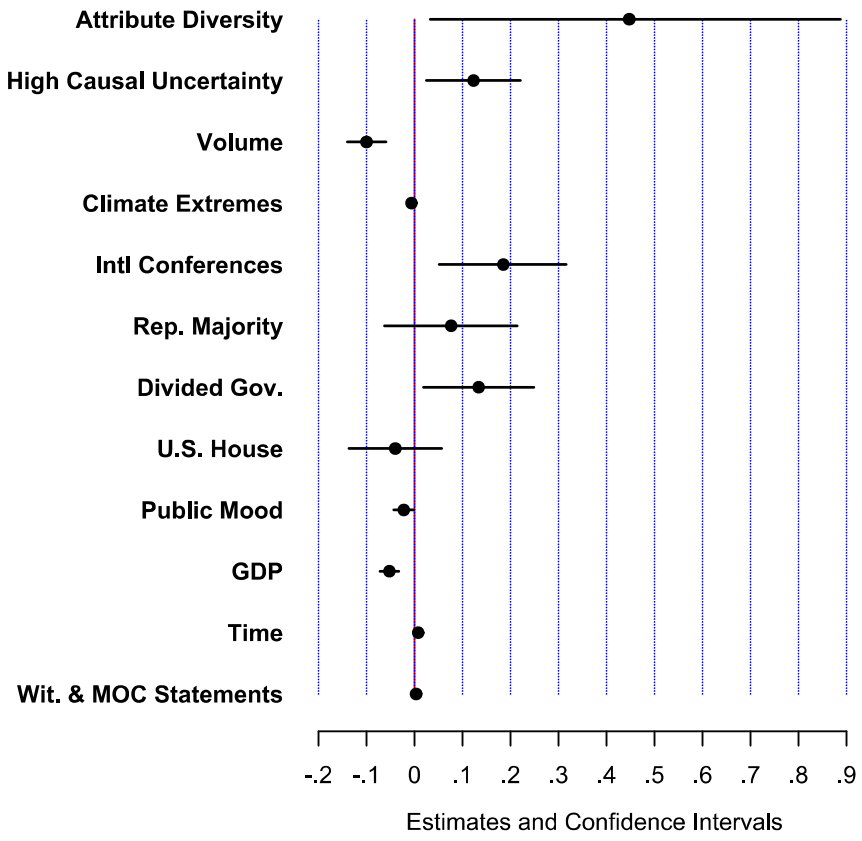

Figure 6.7: Negative Binomial Model: The Number of Incremental Solutions, 1987-2012

The results for attribute diversity in news coverage provides support for the expectation that incremental solutions increase with media signals that amplify the

uncertainty associated with which set of attributes define the climate problem. Problem uncertainty in the policy community shifts consideration to incremental approaches as members compete to better define it and reduce this type of uncertainty. High levels of causal uncertainty are strong signals to policy communities that disputes over causal relationships – i.e. the veracity of causal stories that link carbon emissions to global warming and global warming to damaging climate change impacts – are giving credence to the argument that the relative modesty in the severity of the climate problem only warrants incremental solutions. Volume of climate news coverage has the opposite effect. Policy communities respond to increases in media signals of the importance of the climate problem by shifting debate away from incremental solutions toward more large-scale approaches.[156]

The estimates for international conferences and divided government are positive and statistically significant. The number of incremental solutions increases as international conferences near and when the two leading institutions for climate policymaking – Congress and the White House – are occupied by different political parties. The estimates for public mood and changes in the economy as measured by GDP are negative and statistically significant. This means that the number of incremental solutions decreases when the public turns more liberal and the economy improves, which suggests that policymakers may turn toward more comprehensive approaches to solving the climate problem as a result of liberalism and a good economy.[157] Or, they may devote more resources to understanding the problem to reduce uncertainties surrounding it in light of these conditions.

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[156] The coefficient estimate for volume in the large-scale solutions model was positive. However, it did not reach statistical significance.

[157] The coefficient estimate for GDP is positive and statistically significant in the large-scale model, buttressing this argument. However, mood was negative and did not approach statistical significance.

We now turn to predicted counts of incremental solutions in policy debates to gauge the effects of attribute diversity, causal uncertainty, and volume of climate news coverage. Figure 6.8 shows the predicted number of incremental solutions for increasing values of attribute diversity (top) and volume of news coverage (bottom). The solid black line represents the number of solutions and the gray shading is its 95% confidence interval. Keep in mind that the average number of incremental solutions in policy debates in congressional hearings is 4.1. Note the direction and the steepness of the slope.

For attribute diversity (top), the number of incremental solutions increases alongside stronger media signals that amplify problem uncertainty – i.e. which set of attributes define the climate problem. The predicted number of incremental solutions increases by almost 150% as attribute diversity grows from its lowest to its highest levels. Increasing volume of news coverage has the opposite effect – incremental solutions decrease as climate coverage grows. Policy communities turn to other activities as the media signals about the importance of the climate problem become stronger. They could turn to comprehensive solutions, or they could be refocusing attention back to better defining the problem, as we saw in the last chapter. The predicted number of incremental solutions decrease by nearly 62% from when climate coverage is at its lowest levels to when it is at its peak volume.

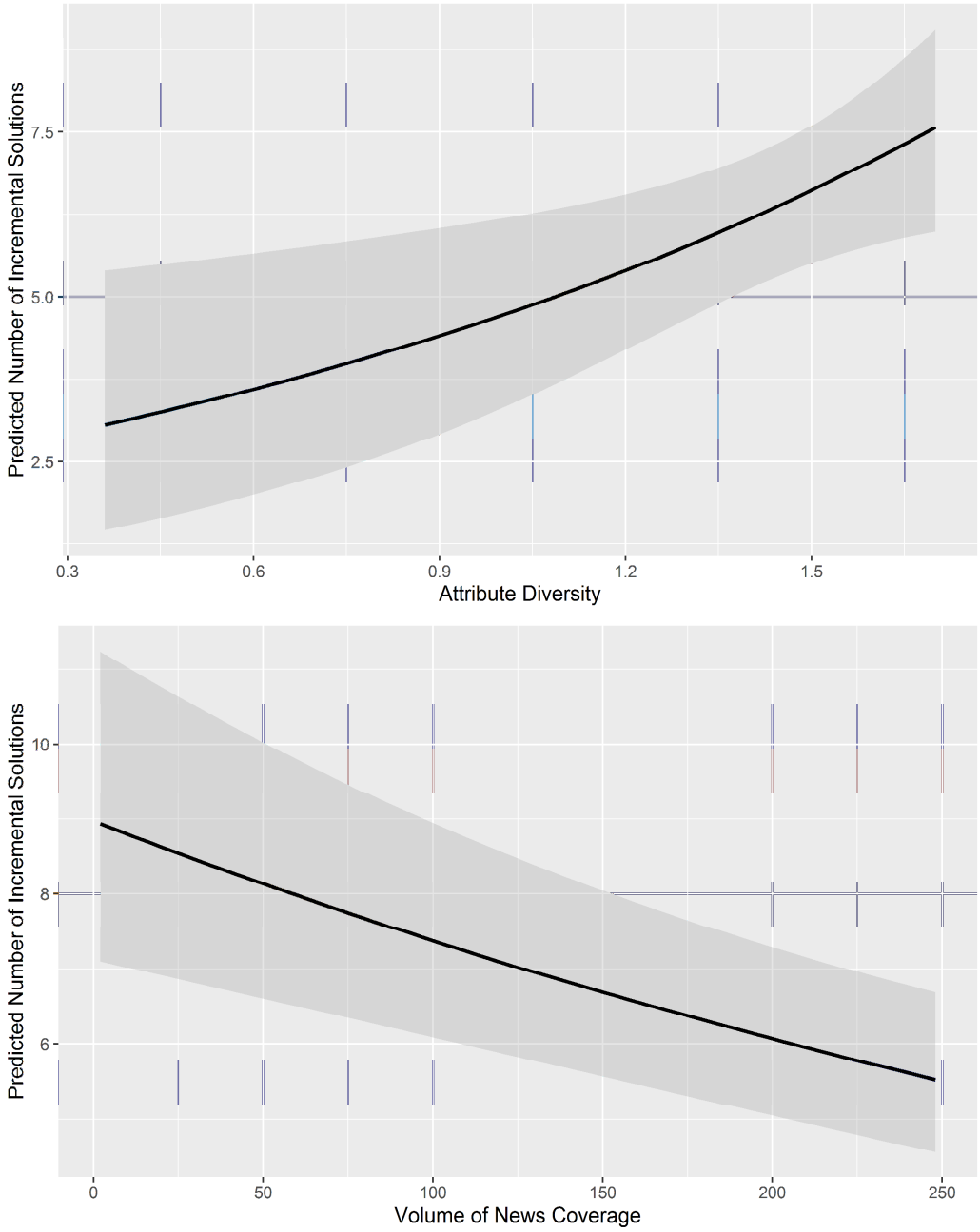

Figure 6.8: Predicted Number of Incremental Solutions for Increasing Values of Attribute Diversity and Volume of News Coverage

Turning to media signals that heighten disputes over problem severity, Figure 6.9 displays the predicted number of incremental solutions for below average (left) and above average (right) levels of causal uncertainty in climate news coverage. Remember that since this is a dichotomous variable, these predicted effects are displayed using what is called a ropeladder plot. The points represent the predicted numbers and the vertical bands the 95% confidence intervals. When causal uncertainty shifts from below average to higher than average, incremental solutions increase by 12% from 5.6 to 6.3. This demonstrates that policy communities respond to large increases in climate news that emphasizes causal uncertainty.

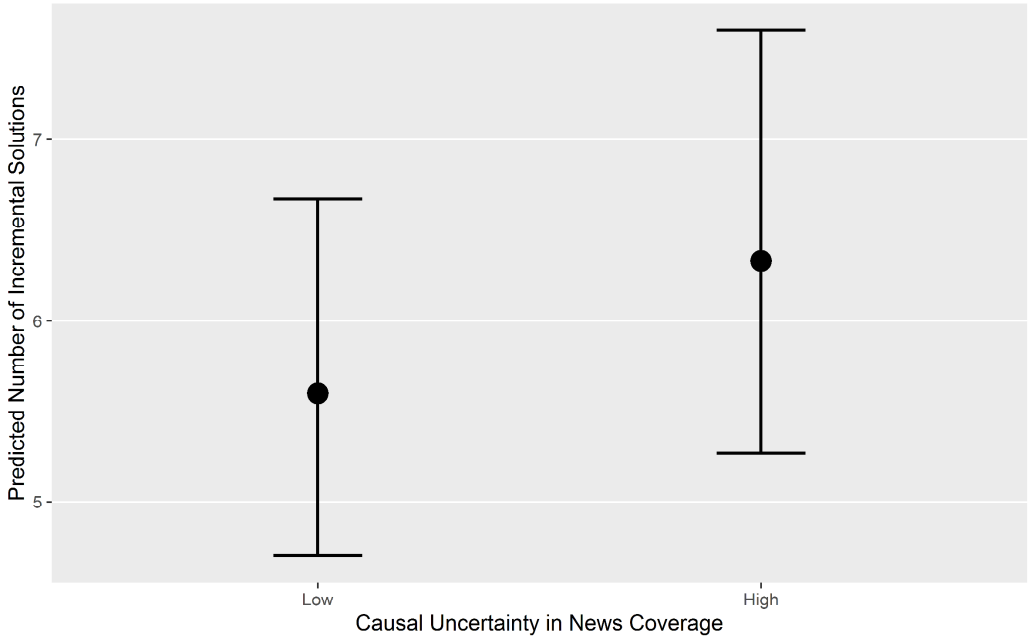

Figure 6.9: Predicted Number of Incremental Solutions by Low/High Levels of Causal Uncertainty

Summary

Chapter 5 showed support for the problem expansion capacity of news coverage. This chapter on solution containment examines how the three aspects of news coverage – attribute diversity, causal uncertainty, and volume – structure the scope of climate solutions considered in policy debates. Does news coverage encourage limited approaches to solving the climate problem, as implied by the logic of media signaling in the muddled space? Findings suggest that high levels of causal uncertainty in news coverage is a limiting factor for the generation of large-scale climate solutions, such as cap-and-trade measures. The results for both attribute diversity and volume's influence on large-scale solutions are in the expected direction, but their estimates do not reach statistical significance.

We also look at how media signals structure the generation of smaller-scale, less costly solutions to the climate problem, such as efficiency increases and enhancing green technologies. The results imply that attribute diversity and causal uncertainty in news coverage play an important role in increasing the likelihood that policy debates on climate solutions will converge around incremental approaches to fixing it. Volume of coverage has the opposite effect, as expected – signals that amplify the importance of the climate problem seem to steer policy debates away from incremental solutions and perhaps toward further deliberating the problem in order to fix it. Results from this chapter also support disproportionate information-processing of some media signals flowing from news coverage, in that signals of causal uncertainty seem to need to be clear and strong before policy communities respond to them. The media play a role in problem expansion *and* solution containment.

Appendices

APPENDIX A: PRIORITIZING THE CLIMATE PROBLEM

Table A.1: Climate Change Topic Codebook

Macroeconomics	
100	General state of the economy, multiple economic effects
103	Job loss and gains, un/employment (e.g., "green" jobs)
108	Industrial health, productivity, and outlook (e.g., coal industry and clean energy legislation)
Health	
300	General and multiple health effects
331	Public health threats from climate shifts and natural disasters (e.g., heat waves), disease(s) from air pollution
Agriculture	
400	Agricultural forecasting, production, costs due to climate shifts
Environment	
700	General and multiple environmental effects, comparisons (e.g., ozone)
705	Greenhouse effect and global warming/climate change (general), combinations of adaptation and mitigation measures, consequences of climate change for "future of planet", proposals to reduce GHG emissions (e.g., EPA regulations, cap-and-trade, carbon tax)
709	Species protection and endangerment, forest management in light of climate shifts (e.g., responding to increasing wildfire threat)
710	Sea-Level rise, coastal erosion, coral reef protection
711	Water supply and conservation measures in response to climate shifts, drought
Energy	
801	Nuclear energy as an alternative to fossil fuels
803	Gas and oil production, prices, supply
805	Coal power plants
806	Alternative and renewable energy
807	Energy efficiency and conservation, fuel efficiency
898	Energy technology investment, development programs
Transportation	
1001	Mass transit and alternative transportation methods (e.g., bicycling)
Social Welfare	
1302	Low income families and climate change (e.g., energy prices)
National Security	
1600	Conflict due to climate shifts and US military involvement

Table Continues Next Page

Table A.1 Continued

Science and Technology	
1701	Climate science (e.g., sources of GHG emissions, causes of climate change, debates over temperature records, climate variability, consequences of global warming, state of climate modeling and prediction, scientific reports)
1702	Climate technology R&D (e.g., geoengineering, earth systems satellites, crossover technology funding, funding programs for collecting climate data)
International	
1902	International treaties, conferences, goals and standards
1905	Developing countries
Actors and Institutions	
2011	Congressional activities
2035	President and administration
2040	Business practices and corporate interests
Public Lands	
2101	Recreation and hunting
Sub-national	
2400	State, local, and regional programs, adaptation policies
Weather	
2600	Weather and natural disasters (general)
2605	Natural disasters (events) (e.g., hurricanes, floods, tornadoes)
2610	Cold waves, heat waves
2615	Drought conditions
2620	Weather forecasting, accuracy
2625	Weather-related disaster response, insurance
Other	
9905	Campaigns and elections
9910	Arts and entertainment (e.g., An Inconvenient Truth)
9915	Travel and recreation, (e.g., ecotourism)
9920	Letters to the Editor

Table A.2: Topic Terms and Codes for Climate News Coverage

Topic Terms	Policy	Topic Terms	Policy
econom much might polici like	100	ice arctic sea melt glacier	1701
american state nation unit econom	100	climat scienc scientist research scientif	1701
tax propos govern cost pay	100	warm climat global chang scienc	1701
program million plan fund project	100	studi scienc comput ocean model	1701
work technolog like one new	103	year human ago planet age	1701
health diseas peopl problem death	331	report climat panel chang scienc	1701
climat chang global warm take	705	energi fuel technolog coal effici	1702
climat chang global warm nation	705	compani busi said execut corpor	1702
said group environment year directo	705	global environment nation warm environ	1900
agenc regul epa air rule	705	china chines unit offici state	1902
emiss carbon trade system allow	705	kyoto treati countri emiss unit	1902
court law state feder regul	705	countri china unit world india	1902
emiss greenhous reduc percent reduct	705	climat countri nation negoti unit	1902
carbon dioxid emiss greenhous gas	705	european said europ unit union	1902
percent year said report increas	705	countri world develop africa nation	1905
speci bear said fish anim	709	bill senat hous legisl democrat	2011
forest tree land fire deforest	709	said hous committe group member	2011
sea rise level water island	710	presid administr hous obama white	2035
plant tree garden water soil	711	administr said bush offici hous	2035
nuclear plant power energi new	801	bush presid administr white plan	2035
oil gas energi drill natur	803	said clinton meet presid confer	2035
percent price cost increas gasolin	803	state california said new governor	2400
plant coal carbon power dioxid	805	counti maryland state virginia million	2400
energi electr power percent wind	806	citi york new mayor build	2400
ethanol crop use product corn	806	chang climat weather hurrican drought	2605
product wast water use environment	807	like winter one snow peopl	2610
build home hous use design	807	water said river region state	2615
car vehicl fuel standard truck	807	democrat republican campaign parti polit	9905
secur war militari unit nation	1600	gore polit truth nobel film	9910
warm temperatur model degre global	1701	offset project use travel get	9915
atmospher carbon effect dioxid earth	1701		

Table A.3: Events: International Climate Summits and IPCC Reports

Event	Year
Montreal Protocol	1987
Toronto Conference and IPCC Creation	1988
IPCC First Assessment Report and Geneva Climate Conference	1990
United Nations Framework Convention on Climate Change (UNFCCC)	1992
IPCC Second Report and Conference of Parties 1 (COP-1)	1995
COP-2	1996
COP-3 Kyoto and Kyoto Protocol	1997
IPCC Third Assessment and COP-7 Morroco	2001
IPCC Fourth Assessment and COP-13 Bali	2007
COP-15 Copenhagen	2009
COP-16 Cancun	2010

Note: Events from 1987-2001 from Liu et al (2011)

Table A.4: Negative Binomial Model: The Number of Hearings per Calendar Quarter, 1987-2012

Variable	Estimate	SE	
(Intercept)	-10.53	2.53	***
Attribute Diversity	1.93	0.75	*
High Causal Uncertainty	-0.43	0.15	**
Volume	0.03	0.00	*
CEI	-0.01	0.01	
International Confs	0.64	0.15	***
Rep. Congress	-0.58	0.15	***
Divided Govt	0.55	0.15	***
Public Mood	0.09	0.02	***
GDP	0.03	0.02	
Time	0.01	0.00	**
Hearing Lag	0.01	0.01	
Ljung-Box Q-test	0.54	(p=0.46)	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

Table A.5: Negative Binomial Model: The Number of Opening Statement, 1987-2012

Variable	Estimate	SE	
(Intercept)	-0.67	0.96	
Attribute Diversity	0.84	0.24	***
Causal Uncertainty	0.54	0.15	***
High Volume	0.20	0.05	***
CEI	0.00	0.00	
International Confs	0.28	0.07	***
Rep. Majority	-0.12	0.08	
Divided Gov.	0.29	0.06	***
US House	-0.28	0.05	***
Public Mood	-0.01	0.01	
GDP	-0.07	0.01	***
Time	0.01	0.01	.

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

APPENDIX B: LIMITING CLIMATE SOLUTIONS

Table B.1: Topic Terms and Code for Hearing Dimensions and Climate Solutions

Topic Terms	Policy	Solution Type
year percent million per billion	100	
cost emiss percent econom polici	100	
industri compani product manufactur prc	108	
job american will coal economi	108	
health pollut air diseas public	331	
agricultur carbon soil land offset	400	I
environment issu polici nation environ	700	
cost tax will price consum	705	L
import need work role issu	705	
need polici believ congress support	705	
effect time term potenti may	705	
chang climat will issu address	705	
problem think issu area way	705	
climat chang adapt impact will	705	
global warm will world action	705	
emiss trade market carbon cap	705	L
emiss program greenhous reduc voluntai	705	I
epa regul act air clean greenhous	705	L
ice arctic sea polar alaska	709	
forest land fire tree manag	709	
ocean coral reef pacif water	710	
chang rise sea level wildlif	710	
carbon coal technolog captur plant	802	I
energi oil gas natur price	803	
fuel ethanol use energi biofuel	806	I
energi electr power generat renew	806	I
energi effici util save conserv	807	I
energi build busi small green	807	I
fuel emiss percent aviat industri	807	I
fuel vehicl standard car economi	807	I
transport transit need new invest	1001	I
peopl communiti live work mani	1302	
chang climat secur nation state	1600	
ozon problem effect deplet also	1701	
energi greenhous global emiss polici	1701	

Table Continues Next Page

Table B.1 Continued

carbon dioxid atmospher emiss fossil	1701	
emiss greenhous climat gas chang	1701	
temperatur year warm record last	1701	
scienc scientist warm scientif climat	1701	
report assess scienc ipcc studil	1701	
climat chang model greenhous warmt	1701	
chang global research program scienc	1701	
technolog energi invest develop clean	1702	I
program feder research agenc plan	1702	
data earth program nasa satellit	1702	
technolog use system can today	1702	
china countri develop india state	1902	
climat countri nation action develop	1902	
kyoto treati protocol countri will	1902	
countri develop world intern project	1905	
senat bill hear committe thank	2011	
bill legisl committe congress will	2011	
administr presid year budget committe	2035	
state local california feder today	2400	
water will drought california state	2615	
climat inform model noaa weather	2620	
climat chang risk insur event	2625	

Note: L = large-scale solution; I = incremental solution

Table B.2: Negative Binomial Model: The Number of Large-Scale Solutions, 1987-2012

Variable	Estimate	SE	
(Intercept)	-0.54	1.34	
Attribute Diversity	-0.08	0.08	
High Causal Uncertainty	-0.17	0.08	*
Volume	0.04	0.04	
CEI	0.01	0.01	
International Conf.	0.11	0.13	
Rep. Majority	-0.18	0.15	
Divided Gov.	0.04	0.10	
U.S. House	-0.26	0.08	**
Public Mood	-0.02	0.02	
GDP	0.08	0.02	***
Time	0.10	0.01	***
Wit & MOC Total	0.01	0.00	***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

Table B.3: Negative Binomial Model: The Number of Incremental Solutions, 1987-2012

Variable	Estimate	SE	
(Intercept)	1.96	0.88	*
Attribute Diversity	0.45	0.22	*
High Causal Uncertainty	0.12	0.05	*
Volume	-0.10	0.02	***
CEI	-0.01	0.00	
International Conf.	0.18	0.07	**
Rep. Majority	0.08	0.07	
Divided Gov.	0.13	0.06	*
U.S. House	-0.04	0.05	
Public Mood	-0.02	0.01	*
GDP	-0.05	0.01	***
Time	0.01	0.01	
Wit & MOC Total	0.00	0.00	.

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

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